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IN THE

Supreme Court of the United States

October Term, 1950

No. 5, Original

STATE OF NEW JERSEY,
Complainant,

vs.

STATE OF NEW YORK AND CITY OF NEW YORK,
Defendants,

COMMONWEALTH OF PENNSYLVANIA,
Intervenor.

MOTION ON BEHALF OF THE CITIZENS BUDGET COMMISSION, INC. FOR LEAVE TO FILE A BRIEF AS *AMICUS CURIAE*

HAROLD RIEGELMAN,
Counsel for The Citizens Budget Commission, Inc.

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MOTION ON BEHALF OF THE CITIZENS BUDGET COMMISSION, INC. FOR LEAVE TO FILE A BRIEF AS *AMICUS CURIAE*

1. This motion is made on behalf of The Citizens Budget Commission, Inc., a non-partisan, fact-finding, non-profit membership corporation. It was organized in 1932 pursuant to the laws of the State of New York, under the auspices of the Chamber of Commerce of the State of New York, the New York Board of Trade, the Merchants Association, the Real Estate Board of New York and others to examine continuously the fiscal affairs of the City of New York and to recommend ways of improving the efficiency of the City's administration. The Commission is supported by voluntary subscriptions of its members, who are the larger mercantile, industrial, banking, financial and service companies of the City and a number of individual citizens.

2. The Commission has, since its establishment, made studies of and reports upon many important phases of the City's government. Its findings have met with acceptance generally by the press and the public, and to a large degree by successive City administrations.

3. Among the objects of its special concern for nearly twenty years has been the quality, quantity and cost of the City's water supply.

4. The Commission's studies and the subsequent and resulting studies by independent engineers of high repute retained by the City of New York have developed facts which bear directly upon the need of the City further to divert the waters of the Delaware River.

5. The consent of the parties to these proceedings for leave to The Citizens Budget Commission, Inc. to file a brief *amicus curiae* was duly requested. The complainant, State of New Jersey, and the intervenor, Commonwealth of Pennsylvania, have consented. The State of New York replied, in effect, that its consent would be conditioned upon that of the City of New York. The City of New York withheld consent on the ground that the relative merits of a source alternative to the Delaware is not in issue in these proceedings and that any attempt to raise that issue would be opposed.

6. It is noted, however, that the City of New York has made allegations in paragraph 15 of its petition, which make the availability and economy of an alternative source an appropriate subject of inquiry, and that the Commonwealth of Pennsylvania has joined issue on that specific point in paragraph 15 of its answer. Point II of the City's brief is devoted to that issue.

7. It is with respect to that issue that The Citizens Budget Commission, Inc. desires to make available to this Court facts and data, and, if appropriate, independent expert testimony, which the City and State of New York will manifestly not voluntarily make available and which, in view of this applicant's long study and intimate knowledge of the problem it believes it can present with greater particularity and effectiveness than either of the two parties opposing the City's motion. The contribution which The Citizens Budget Commission, Inc., desires to make to a solution of the issues at bar arises out of the following circumstances.

8. Since 1933, this applicant has from time to time made studies and recommendations relating to the second phase of the development of the Delaware watershed and adjacent upland sources. In February, 1950, Messrs. Lawrence T. Beck, a consulting engineer and later a trustee of the Commission, and Dean G. Edwards, the Commission's then consulting engineer, completed and the Commission presented to the Board of Water Supply of the City of New York a plan for the pumping, filtration and treatment of the waters of the upper Hudson River for future auxiliary supply to the City of New York and dependent suburban communities. An investigation of the plan was requested by the Commission with a view toward its adoption in lieu of further exploitation of the Delaware watershed after completion of the second phase of that development which is expected to be finished in 1956.

9. The Board of Water Supply refused to make the study, and continued to press its application for permission to pursue the Cannonsville project described in movant's petition, before the New York State Water Power and Control Commission.

10. By reason of said refusal the then Mayor of the City of New York announced that he would cause his Committee on Management Survey to retain a panel of eminent and independent engineers to investigate the several sources of future water supply for the City; and subsequently such a Panel of engineers under the chairmanship of Dean Thorndike Saville was retained and began its studies in or about June 1950 and concluded them a year later.

11. The exhaustively supported findings of the Panel in brief were that:

a. The Cannonsville project will not satisfy the requirements of the City of New York beyond 1970 or some time between 1970 and 2000 A. D. if the Board of Water Supply's estimate of the City's future water consumption proves to be correct. Therefore, even if the Cannonsville project were constructed additional sources would have to be sought and developed at additional cost about or soon after 1970.

b. The cost of Cannonsville as estimated by the Board of Water Supply will be $140 million.

c. The waters of the upper Hudson River in the vicinity of Hyde Park are a safe source of water in sufficient abundance to accommodate the water needs of the City of New York in perpetuity and the construction cost of pumping, filtration, treatment and aqueduct facilities to the City's inlying reservoirs would be $40 million.

d. The quality of the water thus supplied would be at least equal to and probably better than the City's present supply and would possess a greater factor of safety.

e. In contrast to the Cannonsville project, the great cost of which must be amortized and serviced whether much or little use is made of its water, the low-cost Hudson supply is sufficiently flexible to permit maintenance on a fractional or standby basis at a moderate or nominal cost.

f. The exposure of the City's water system to atomic or bacteriological attack or sabotage would be materially less if the Hudson River, a free-flowing, self-cleansing stream, were available for auxiliary use than if the present closed system were merely extended by the addition of waters impounded and released at Cannonsville.

12. The Panel recommended, in addition to certain conservation measures, that final engineering studies and cost estimates be prepared in relation to the use of the upper Hudson River as an auxiliary source of water supply.

13. This recommendation was vigorously resisted by the Board of Water Supply during the ensuing deliberations of the Mayor's Committee and of its Subcommittee on water. But both of these latter bodies confirmed the recommendation of the Panel and submitted it to the present Mayor. The Mayor, by referring it to the Board of Water Supply, which has steadfastly declined to consider the Hudson River source, in effect, rejected the work of the Panel. While the matter was still before the Mayor's Committee, the City made its motion herein.

14. In the course of the foregoing events a substantial amount of pertinent and valuable data was accumulated by The Citizens Budget Commission, Inc., establishing the improvidence and absence of any need for the City of New York to divert more water from the Delaware than

is permitted by the original decree of this Court, of which the City of New York now asks an unwarranted relaxation.

15. It is these data, which the City is unlikely to present, and which it is believed that the other parties to these proceedings will be unable to present as fully as The Citizens Budget Commission, Inc., that the applicant asks leave to make available by brief *amicus curiae,* and, if appropriate, by the testimony of its own engineers and those of the Mayor's Committee on Management Survey.

Respectfully submitted,

HAROLD RIEGELMAN,
Attorney for Applicant,
The Citizens Budget Commission, Inc.

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HAROLD B. WILLEY, CLERK

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Defendants,

COMMONWEALTH OF PENNSYLVANIA, and
STATE OF DELAWARE,
Intervenors.

REPORT OF THE SPECIAL MASTER

Recommending Amended Decree

KURT F. PANTZER,
Special Master,
1313 Merchants Bank Building,
Indianapolis 4, Indiana.

Filed May 27, 1954

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Of Counsel.

For the State of New York, Defendant:

Hon. NATHANIEL L. GOLDSTEIN, Attorney General,
By WENDELL P. BROWN, Esq., Solicitor General,
EDWARD L. RYAN, Esq., Assistant Atty. General.

For the City of New York, Defendant:

Hon. ADRIAN P. BURKE, Corporation Counsel,
By JOHN P. McGRATH, Esq.,
JEREMIAH M. EVARTS, Esq.,
RICHARD H. BURKE, Esq.,
JAMES J. THORNTON, Esq.,
Of Counsel.

For the Commonwealth of Pennsylvania, Intervenor:

Hon. FRANK F. TRUSCOTT, Attorney General,
By GEORGE G. CHANDLER, Esq.,
BERNARD G. SEGAL, Esq.,
Special Counsel and Solicitors.
WILLIAM A. SCHNADER, Esq.,
HARRY F. STAMBAUGH, Esq.,
Special Counsel.

For the State of Delaware, Intervenor:

Hon. H. ALBERT YOUNG, Attorney General,
VINCENT A. THEISEN, Esq., Chief Deputy Attorney General.

IDENTIFICATION OF WITNESSES

(The following list of witnesses is here set forth for the convenience of the Court in identifying them when they are referred to in the text of this Report)

New York City Witnesses

Huie, Irving V. A.	Civil Engineer	President, New York City Board of Water Supply
Pratt, Henry Z., Jr.	Civil Engineer	Deputy Chief Engineer, New York City Board of Water Supply
Terenzio, Vincent G.	Civil Engineer	Division Engineer, New York City Board of Water Supply
Kennison, Karl R.	Civil Engineer	Chief Engineer, New York City Board of Water Supply
Marston, Frank A.	Civil Engineer	Consulting Engineer on Sanitary Engineering, New York City Board of Water Supply, and Partner Metcalf & Eddy, Boston, Mass.
Glancy, Joseph B.	Biological Engineer	Employed as Consultant to New York City Board of Water Supply and Biological Engineer for Blue Points Co., Inc., Northport, L. I., N. Y.
Ketchum, Bostwick H.	Marine Microbiologist	Woods Hole Oceanographic Institution, Woods Hole, Mass.

New Jersey Witnesses

Critchlow, Howard T.	Chief Engineer and Director	New Jersey Division of Water Policy and Supply, Department of Conservation and Economic Development
Sherman, Arthur L.	Consulting Engineer on Water Supply	Washington, D. C.
Cassedy, Thomas S.	Consulting Engineer	Partner Whitman, Requardt and Associates, Baltimore, Md.
Whitman, Ezra B.	Consulting Engineer	Senior Partner Whitman, Requardt and Associates
Powell, Sheppard T.	Consulting Engineer	Baltimore, Maryland

Acken, Howard W.	Supervising Engineer	Delaware and Raritan Canal
Smith, Herbert H.	Chief of Planning Section	New Jersey Department of Conservation and Economic Development
Peterson, Henry W.	Secretary	South Jersey Port Commission
Morrill, Leigh W.	District Chief	Public Health Engineer, New Jersey Department of Health
Nelson, Thurlow C.	Biologist	Division of Shell Fisheries, New Jersey Department of Conservation and Economic Development
Haskin, Harold H.	Director of Research	New Jersey Oyster Research Laboratory

Pennsylvania Witnesses

LaBrum, J. Harry	Attorney at Law	President, Chamber of Commerce of Greater Philadelphia
Baxter, Samuel S.	Professional Engineer	Water Commissioner, City of Philadelphia
Greeley, Samuel A.	Civil and Sanitary Engineer	Consulting Engineer, Greeley & Hansen, Chicago, Illinois
Ryder, Charles E.	Civil Engineer	Consulting Engineer, Harrisburg, Pennsylvania
Corddry, W. H.	Civil Engineer	Consulting Engineer, Gannett, Fleming, Corddry & Carpenter, Harrisburg, Pennsylvania
Haseltine, Theodore R.	Sanitary Engineer	Consulting Engineer, Chester Engineers, Pittsburgh, Pennsylvania
Wolman, Abel	Consulting Sanitary Engineer	Consulting Engineer, Professor, Johns Hopkins University, Baltimore, Maryland

Delaware Witnesses

Gassaway, Gerrish		Executive Vice-President, Delaware Chamber of Commerce
Hyer, Frank P.	Engineer	Vice-President, Delaware Power and Light Company
Myers, Ward R.	Engineer	Research and Consulting Engineer in fields of Corrosion and Materials Engineering—E. I. du Pont de Nemours Co.
Wilder, Norman G.	Conservationist	Director of Conservation of Delaware Board of Game and Fish Commissioners
Cronin, Lewis Eugene	Biologist	Associate Professor of Biological Sciences, University of Delaware; Marine Biologist for the State of Delaware
Groot, Johan J.	Geologist	Delaware State Geologist

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REPORT OF THE SPECIAL MASTER

Recommending Amended Decree

ARTICLE 1

The Order of Appointment, the Hearings and the Record

Sec. 1.01. The Order of Appointment. This Honorable Court appointed the undersigned as Special Master in this cause by its Order dated June 9, 1952. The Order contained the following directive:

> "IT IS ORDERED that the petition of the defendant, City of New York, for modification of the decree entered herein May 25, 1931, (283 U. S. 805), the memorandum of the defendant, State of New York,

and the answers to the petition filed by the State of New Jersey and the Commonwealth of Pennsylvania, be referred to Kurt F. Pantzer, Esquire, of Indianapolis, Indiana, as a Special Master, with directions and authority to proceed to a consideration of the issues involved and to report to the Court with all convenient speed his recommendations in respect of the amendment of the decree, if any.

"The Special Master is authorized to employ stenographic and clerical help, to fix times and places for taking evidence, to issue subpenas to witnesses, including those of his own selection, and to administer oaths. When the report of the Special Master is filed the Clerk of the Court shall cause the same to be printed. The Special Master shall be allowed his actual expenses and a reasonable compensation for his services to be fixed hereafter by the Court. The allowances to him, the compensation paid to his stenographic and clerical assistants, and the cost of printing his report shall be charged against and be borne by the parties in such proportions as the Court hereafter may direct."

Sec. 1.02. The Hearings. After making a thorough study of the Report filed by Charles N. Burch, Esquire, Special Master in the original 1929 proceeding; the decision of this Court rendered May 25, 1931 (283 U. S. 336); the Decree entered by this Court on May 25, 1931 (283 U. S. 805); the printed Transcript of the Record in that case; and the original pleadings in the present proceeding; the Special Master met counsel representing the State of New Jersey, State of New York, Commonwealth of Pennsylvania, and City of New York, being the then existing parties to the proceeding, in the City of New York on July 29, 1952 and arranged for a pre-hearing inspection of the Delaware River and its tributaries and Delaware Bay, which lasted from August 5th to August 9th, both

inclusive. Inasmuch as it appeared that the convenience of the parties, counsel and numerous witnesses would be served by holding hearings in the East, the same were held in the cities of New York, Philadelphia, Trenton and Washington, on October 3rd, December 3rd and 4th, 1952; January 26th, March 2nd, May 22nd, June 9th, June 17th, July 14th, August 7th, and September 18th, 1953, and were devoted principally to the application of pre-trial techniques for the solution of the problems of procedure and the issues as presented by the parties. In these more or less formal pre-trial hearings, and many additional informal meetings, it was finally decided that the various problems of the proceeding could best be solved by negotiation rather than the usual processes of adjudication. Thereafter, New York City began the introduction of its testimony and exhibits at a hearing on October 15, 1953, and concluded its presentation at a further hearing on February 19, 1954. New Jersey introduced its testimony and exhibits at a hearing held March 5, 1954, and Pennsylvania introduced its testimony and exhibits at a hearing held March 26, 1954. The testimony and exhibits of the State of Delaware, as well as further testimony and exhibits on the part of the other parties, were introduced at hearings held April 9 and 15, 1954. Final conferences respecting this Report of the Special Master were conducted in Indianapolis, Indiana, on May 17 and 18, 1954, and in Washington, D. C. on May 20 and 21, 1954.

Sec. 1.03. The Record. Inasmuch as the present case relates to scientific issues, the Rule of this Court relating to records in patent cases has been followed which permits the submission of the record "in such size as is necessary to utilize copies of patent documents"—namely, 8 by 10½ inches—many copies of reduced scientific exhibits having been bound both in the volumes of testimony, and in the

volumes of exhibits, herewith tendered. There are accordingly being filed with the Clerk of this Court contemporaneously with the filing of this Report the following volumes bound in boards and blue linen:

No. of Volume	Contents
I	New York Testimony
II	New York Testimony
III	New Jersey Testimony
IV	Pennsylvania Testimony
V	Pennsylvania Testimony
VI	Delaware Testimony
VII	New York Exhibits
VIII	New York Exhibits
IX	New York Exhibits
X	New Jersey Exhibits
XI	Pennsylvania Exhibits
XII	Delaware Exhibits

The Special Master understands that certain of the parties desire hereafter to prepare and bind subject indices of their testimony and exhibits. Copies of such volumes, when and if prepared, will be numbered in series from XIII to XVI, and if completed will also be filed with the Clerk of this Court. Attention is, however, called to the fact that an Index to the testimony or exhibits set forth in each volume will be found at the end of the volume. It has been found impossible to reduce to suitable binding size, and to bind, the following forty-one exhibits: New York City Exhibits 7, 8-31, incl., 33, 34, 39, 41, 41-A, 42-50, incl., and 55; and Pennsylvania Exhibit 226. They have, accordingly, been folded and housed in three container boxes, of which one is 26½ by 42½ by 1½ inches, one is 12 by 18 by 7 inches, and one is 12½ by 24 by 4 inches, and labeled "Unbound Exhibits" Volumes A, B and C, and one folder, Volume D containing Pa. Ex. 226. One set of such boxes with exhibits has also been filed with the Clerk of this Court.

ARTICLE 2

The 1929-1931 Proceeding

Sec. 2.01. The Contentions of the Parties. On May 22, 1929 (Pr. R. 4752),[1] New Jersey filed its original bill of complaint in the Supreme Court of the United States alleging that the City of New York acting under State authority proposed to divert from the Delaware River watershed for its water supply the equivalent of 600 m.g.d.[2] of water, and that the proposed diversion would irreparably injure the State of New Jersey and its people. The bill further alleged that there was no necessity for this interstate diversion because of the existence and availability of other suitable sources of supply in New York that were intrastate and adequate and because of New York's waste of its existing supply. The bill prayed for an injunction (Pr. R. 4535-36, 4752-56).

The answers of the State and City of New York (1) admitted the proposed diversion, but claimed it would be beneficial instead of injurious, because they planned to impound only flood and waste waters, a part of which would be released to augment stream flow in the Delaware River during periods of low flow and dry weather; (2) set forth that New York State had unsuccessfully attempted in 1925 and 1927 to negotiate compacts with New Jersey and Pennsylvania, and alleged that the proposed diversion would be in accordance with the principles of the unadopted compacts; (3) denied the charges of non-necessity and waste; and (4) prayed for the dismissal of the New Jersey bill (Pr. R. 4557-88, 4756-58).

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[1] Page references to the previous record in the original proceeding No. 16, October Term 1930, will bear the prefix "Pr. R." All other references are to the present Record, the name of the witness preceding the reference.

[2] m.g.d. is the abbreviation for million gallons daily.

Over the objection of all parties, the Commonwealth of Pennsylvania was allowed to intervene *pro interesse suo* upon filing a Statement of Interest and Relief desired, which stated that the Commonwealth was interested in the development and best utilization of the water resources of the Delaware River and its tributaries because its inhabitants and municipalities must look to those water resources to meet their present and reasonable future needs. It further stated that Pennsylvania was opposed to the application of the common law doctrine of riparian rights as advocated by the New Jersey bill, because that doctrine would prevent the development and use of the Delaware River and its tributaries as a present and future source of water supply for Philadelphia and eastern Pennsylvania; and that if, on the other hand, the proposed New York plan of impounding and release should upon hearing prove to be not in accordance with a fair and equitable division of the waters of the Delaware River and its tributaries between the three States, Pennsylvania would require such relief as might be necessary and appropriate. It insisted that the New York diversion must not constitute a prior appropriation and should be taken reasonably into account in any subsequent or final allocation of the waters of the Delaware (Pr. R. 4589-97, 4758-60).

Sec. 2.02. The Evidence. The extensive oral and documentary evidence offered by New Jersey and the State and City of New York was mainly directed to two disputed issues of fact, namely: (1) whether the proposed New York diversion would substantially harm navigation, water power, sanitation, industrial use, oysters, fish, water supply, agriculture and recreation in the Delaware Valley basin; and (2) whether the New York diversion was necessary, which issue in turn depended upon whether New York was wastefully using its existing water supply and

whether it possessed other available intrastate supplies that were adequate and suitable.

The principal legal issues between those parties were (1) what principle should govern the use of interstate waters, (2) whether such waters could lawfully be diverted to another watershed for water supply purposes, and (3) where did the balance of equity lie.

The separate proofs of Pennsylvania were confined to showing (1) the adequacy of the Delaware River and its tributaries to meet the estimated present and reasonable future water needs (at that time estimated at 1750 m.g.d.) of the three States under a proper plan of impounding and release, (2) the superiority of the Pennsylvania plan, which would avoid substantial damage both when New York was presently taking and later when the three States were taking Delaware River water, (3) the necessity for a present allocation of Pennsylvania's fair and equitable share in the waters of the Delaware River and its tributaries, and (4) the advisability of appointing a River Master.

Pennsylvania maintained that the principle of equitable division should be applied, under which the waters of the Delaware River and its tributaries would be fairly and equitably apportioned among the three States in the absence of material damage. Pennsylvania alone requested retention of jurisdiction over the cause.

Sec. 2.03. The Master's Report. The comprehensive report of the Special Master reviewed in detail the pleadings, proofs and applicable principles of law; and then made certain general and specific findings of fact and conclusions of law, upon which were based his recommendations for a decree (Pr. R. 4752-4973). Those findings, conclusions and recommendations, which are of controlling importance in the present case, may be grouped under

three categories, the first of which pertains to the principle of equitable division, the second to the question of damages, and the third to the retention of jurisdiction over the cause.

The primary issue under the first category was what principle of law should be applied in dividing the interstate waters of the Delaware River and its tributaries. After reviewing the common law rule of riparian rights, which with certain limitations prevailed in the three States (Pr. R. 4761-75), and the interstate common law doctrine of fair and equitable apportionment as laid down by the Supreme Court of the United States in *Kansas* v. *Colorado,* 206 U. S. 46 (1907), *Wyoming* v. *Colorado,* 259 U. S. 419 (1922), and *Wisconsin* v. *Illinois,* 278 U. S. 367 (1929) (Pr. R. 4776-83), Special Master Burch decided that the interstate common law doctrine of fair and equitable apportionment should prevail and be applied (Pr. R. 4776, 4945-46; 7th and 41st Findings and Conclusions, Pr. R. 4960-61, 4967).

Shortly after the filing on February 2, 1931 of the report of Special Master Burch, the Supreme Court of the United States decided *Connecticut* v. *Massachusetts,* 282 U. S. 660 (1931) in which it held that the controversy over the proposed diversion by Massachusetts of the interstate waters of the Ware and Swift tributaries of the Connecticut River out of the watershed for water supply purposes for Boston and its metropolitan area should be determined under the principle of equitable division rather than under the common law doctrine of riparian rights which prevailed in both States. Therefore, when exceptions to the report of the Special Master were heard and decided two months later, the Supreme Court of the United States in an opinion delivered by Mr. Justice Holmes said, *New Jersey* v. *New York,* 283 U. S. 336, 343 (1931):

> "This case was referred to a Master and a great mass of evidence was taken. In a most competent and excellent report the Master adopted the principle of equitable division which clearly results from the decisions of the last quarter of a century. Where that principle is established there is not much left to discuss. The removal of water to a different watershed obviously must be allowed at times unless States are to be deprived of the most beneficial use on formal grounds. In fact it has been allowed repeatedly and has been practiced by the States concerned. *Missouri* v. *Illinois*, 200 U. S. 496, 526. *Wyoming* v. *Colorado*, 259 U. S. 419, 466. *Connecticut* v. *Massachusetts*, 282 U. S. 660, 671."

A necessary corollary to the adoption and application of the principle of equitable division was the equally important proposition of law, advanced solely by Pennsylvania, that "any present allocation of Delaware River water to the State and City of New York should not constitute a prior appropriation but should be chargeable against their fair and equitable share in said waters." Special Master Burch considered this proposition sound and did not think that the mere fact that the State and City of New York were first in point of time in taking water from the tributaries of the Delaware River gave any superiority of right (Pr. R. 4950). He so found in his 46th Finding and Conclusion and his 5th Recommendation for a decree (Pr. R. 4967-68, 4972).

This proposition was likewise adopted by the Supreme Court of the United States in its opinion and was incorporated in paragraph 2 of the decree of May 25, 1931 (283 U. S. 336, 347, 806):

> "2. The diversion herein allowed shall not constitute a prior appropriation and shall not give the State of New York and City of New York any

superiority of right over the State of New Jersey and Commonwealth of Pennsylvania in the enjoyment and use of the Delaware River and its tributaries."

A third basic issue under the first category was the preservation of the equality of right of each State under the Constitution in applying the principle of fair and equitable apportionment to a division of the interstate waters of the Delaware River and its tributaries. Special Master Burch stressed the ruling of the Supreme Court of the United States in the case of *Wyoming* v. *Colorado, supra,* that the "equality of right" did not refer to an "equal division of the water, but to the equal level or plane on which all the States stand in point of power and right under our constitutional system" (Pr. R. 4778-79; 11th Finding and Conclusion, Pr. R. 4961). That the unequal water needs of New York, New Jersey and Pennsylvania might require corresponding unequal division of the available waters of the Delaware River and its tributaries has been recognized by the parties and has never been questioned since the proposed compacts of 1925 and 1927 which failed of ratification (Pr. R. 4788).

A fourth fundamental issue under the first category was whether or not the application of the principle of equitable division to the interstate waters of the Delaware River and its tributaries was precluded by reason of the New Jersey proofs that there were other intrastate sources of water supply in the State of New York, the taking from which could not affect the other two States. Special Master Burch found that the selection of the Delaware River tributaries as a source of water supply for the City of New York was not arbitrary but was founded upon sound and substantial reasons; that such selection was a matter of internal policy for the State and City of New York which should not be controlled by another State

unless their choice of an interstate water supply was arbitrary and unreasonably injured the other State; and that unless New Jersey would be substantially injured by the proposed diversion the availability of intrastate sources of supply would not bar the right of the State and City of New York to select and make use of the tributaries of the Delaware River as an additional source of water supply (Pr. R. 4789-4803; 8th and 18th Findings and Conclusions, Pr. R. 4961-62). The Special Master found that the New York proposed diversion of 600 m.g.d. of Delaware River water was excessive, and reduced the same to 440 m.g.d. in order to avoid substantial injury to New Jersey (39th to 43rd, inclusive, Findings and Conclusions, Pr. R. 4966-67).

The fifth and last major issue under the first category was the request for a present allocation to Philadelphia and eastern Pennsylvania of 750 m.g.d. from the Pennsylvania tributaries of the upper Delaware River as their fair and equitable share. The Special Master denied the request without prejudice upon the grounds that it was not embraced within the scope of Pennsylvania's Statement of Interest and Relief desired, and that there was no present or definite project for such an additional water supply (Pr. R. 4946-50; 45th Finding and Conclusion and 6th Recommendation, Pr. R. 4967, 4972). On exceptions to the report, this ruling of the Special Master was affirmed and embodied in the May 25, 1931 decree of the Supreme Court of the United States (283 U. S. 336, 347, 807).

With respect to the controverted issue of what damage, if any, would result from the proposed New York diversion of 600 m.g.d. from the Delaware River and its tributaries, Special Master Burch first analyzed the respective proofs of New Jersey and the City and State of New York pro and con with respect to each of the nine particular items of

damage specified in the New Jersey bill as well as the separate proofs of Pennsylvania that no substantial damage would be caused by the proposed New York diversion if taken pursuant to the Pennsylvania plan of impounding and release (Pr. R. 4827-4934). From such analyses he generally found and concluded (a) that the proposed New York project would cause slight damage to all items save recreation and oysters, as to which the damage would be somewhat more than slight; (b) that adding all of these elements of damage together gave a total of substantial damage which in his opinion was more than New Jersey should be expected to bear; (c) that because the taking of 600 m.g.d. was excessive and would cause substantial damage, the proposed New York diversion should be reduced from 600 m.g.d. to 440 m.g.d. in order to avoid inflicting substantial damage on New Jersey and its citizens; (d) that such reduced amount must be taken under the Pennsylvania plan of impounding and release; and (e) that the taking of 440 m.g.d. did not exceed New York's fair share under the doctrine of equitable apportionment, but that a diversion of more than that quantity would be excessive (Pr. R. 4952-59). These general findings and conclusions were summarized in his 27th to 43rd, inclusive, and 54th Findings and Conclusions (Pr. R. 4964-67, 4968).

He recommended that an injunction restraining the State and City of New York from diverting any water whatever from the Delaware River and its tributaries, as requested by New Jersey, or an amount up to the equivalent of 440 m.g.d. should be denied (1st and 2nd Recommendations, Pr. R. 4970); that New Jersey should, however, be granted an injunction restraining the State and City of New York from diverting more than the equivalent of 440 m.g.d. (3rd Recommendation, Pr. R. 4970); and that the taking of 440 m.g.d. should be conditioned upon the treatment of the sewage and industrial waste of Port

Jervis and the impounding and release of water in accordance with the Pennsylvania plan (4th Recommendation, Pr. R. 4970-71).

The Commonwealth of Pennsylvania by its intervention sought a present allotment of 750 m.g.d. from the Pennsylvania tributaries of the upper Delaware River as the fair and equitable share of Philadelphia and eastern Pennsylvania in the waters of that River at that time, and also the present appointment of a Delaware River Master, in order that the Pennsylvania plan of impounding and release might be more effectively operated. Both requests were denied without prejudice by Special Master Burch (Pr. R. 4946-50, 4951-52; 46th and 47th Findings and Conclusions, 6th and 7th Recommendations, Pr. R. 4967-68, 4972). He also approved for the present the Pennsylvania plan of impounding and release subject to such modifications as actual tests and experience might indicate (Pr. R. 4950-51; 48th Finding and Conclusion, 4th (b) Recommendation, Pr. R. 4968, 4971).

Retention of jurisdiction over the cause, which Pennsylvania alone had asked, was recommended by Special Master Burch who limited the same to appropriate applications for relief as to any matter determined without prejudice (*i.e.*, the denial of the Pennsylvania prayers for a present allocation and the appointment of a River Master), and also for a modification of the provisions relating to the treatment of sewage at Port Jervis and the Pennsylvania plan of impounding and release (9th Recommendation, Pr. R. 4972-73).

Sec. 2.04. The Exceptions to the Master's Report. The State and City of New York respectively filed separate exceptions to the Report of Special Master Burch. New York State divided its exceptions into the three general classes of (1) those findings, conclusions and recommendations that the defendants (State and City of New York)

should be enjoined from diverting more water than 440 m.g.d. (Pr. R. 4997-99), (2) those holding that New York's proposed diversion of 600 m.g.d. was excessive, would cause substantial damage, and entitled New Jersey to an injunction (Pr. R. 4999-5003), and (3) those recommending that the decree should not be final but should be subject to modification (Pr. R. 5003-04). In support of its exceptions in the first case, New York State assigned as a special reason that a decree enjoining the diversion of more than 440 m.g.d. "would forever forbid both defendants from diverting more water, no matter what their necessities might be in the future" (Pr. R. 4998).

Similarly, the separate exceptions of New York City were grouped into (1) those findings, conclusions and recommendations that the proposed New York diversion of 600 m.g.d. was excessive, would cause substantial damage and should be enjoined in any amount exceeding 440 m.g.d. (Pr. R. 5005-07), (2) those recommending that the cause should not be finally determined by the decree to be entered (Pr. R. 5008), and (3) those pertaining to the failure and refusal of the Special Master to find and conclude, as requested by New York City, that the proposed taking of 600 m.g.d. was reasonable, proper in amount, and "not in excess of the fair and equitable share of the State of New York in the waters of the said river" (Pr. R. 5015).

In its brief before the Supreme Court of the United States, New York City argued at great length (a) that the proposed diversion of 600 m.g.d. did not "exceed the fair share of the State of New York in the waters of that (Delaware) river under the doctrine of equitable apportionment"; (b) that the retention of jurisdiction was unnecessary; and (c) that the interests of New York City were too large to permit any uncertainty or experimentation in the decree and that "nothing but a decree definite

and final in all its particulars would warrant it in embarking upon its project."

Likewise, the brief of New York State on appeal emphasized (a) that the limit of 440 m.g.d. imposed by the Special Master upon New York's diversion of Delaware River water would unduly restrict its future needs; and (b) that the decree should be final and not subject to modification.

Solely because the oral and documentary proofs of Pennsylvania in the 1929-31 proceedings showed that the Delaware River and its tributaries had sufficient water to supply without substantial damage the total present and reasonable future needs of New York, New Jersey and Pennsylvania, which the Commonwealth then estimated at 1750 m.g.d., the latter did not in the first instance object to the proposed taking of 600 m.g.d. for the City of New York provided such taking was under the Pennsylvania plan of impounding and release. At that time the recent tremendous growth and development of "Delaware Valley U. S. A.," consisting of Bucks, Chester, Delaware, Montgomery and Philadelphia counties in Pennsylvania; Burlington, Camden, Gloucester, Mercer and Salem counties in New Jersey and New Castle county in Delaware, were in no manner foreseen.

No exceptions to the Report of Special Master Burch were filed by Pennsylvania. However, in its brief Pennsylvania maintained that jurisdiction should be retained by the Court for the limited purposes of (1) a future allocation of Pennsylvania's fair and equitable share of Delaware River water, (2) the future appointment of a River Master, and (3) whatever modification might be required of the provisions of the decree regarding the treatment of sewage by Port Jervis, the Pennsylvania plan of impounding and release, and the inspection of the New York reservoirs by New Jersey and Pennsylvania. The posi-

tion of the Commonwealth was otherwise in full accord with the recommendations of the Special Master.

Sec. 2.05. The Supreme Court Decision and Decree. The Supreme Court of the United States confirmed the Report of the Special Master; ordered the entry of a decree denying the injunction prayed for by New Jersey so far as it would restrain the State and City of New York from diverting from the Delaware River or its tributaries to the New York City water supply the equivalent of 440 m.g.d., but granting an injunction to restrain such State and City from diverting water in excess of that amount; and broadened the scope of the jurisdiction retained over the cause (283 U. S. 336, 345-46, 348).

In recognition of the possible future necessity of modifying the decree the opinion delivered by Mr. Justice Holmes prophetically observed (283 U. S. 334, 344):

> "* * * Of course in that particular as in some others New York takes the risk of the future. If the War Department should in future change its present disinclination to interfere, New York would have to yield to its decision, and the possible experiences of the future may make modifications of the plan as it now stands necessary in unforeseen particulars. This will be provided for in the decree. * * *"

By reason of these uncertain risks of the future, paragraph 6 of the decree was inserted by this Court at its own instance, and provided (283 U. S. 336, 348, 807):

> "6. Any of the parties hereto, complainant, defendants or intervener, may apply at the foot of this decree for other or further action or relief and this Court retains jurisdiction of the suit for the purpose of any order or direction or modification of this decree, or any supplemental decree that it may deem at any time to be proper in relation to the subject matter in controversy."

This retention of jurisdiction, so much broader than that recommended by Special Master Burch, was essential in view of the specific holdings that (1) the allowance of a New York diversion of 440 m.g.d. should neither constitute a prior appropriation nor give any superiority of right, and (2) the State and City of New York must take "the risk of the future" that their plan might require modification.

ARTICLE 3

The 1952-1954 Proceeding

Sec. 3.01. The Original Pleadings.

Cl. 3.011. The Original Petition of New York City. On April 1, 1952, New York City filed its petition (in which the State of New York later joined) for modification of the decree of May 25, 1931. The petition alleged that the City sought to increase its diversion of Delaware River water for water supply purposes from the 440 m.g.d. authorized by that decree to 800 m.g.d. because its consumption and use of water had since increased to such an extent that its existing water facilities with a safe dependable yield of 1120 m.g.d. were overtaxed and would be insufficient to meet the City's anticipated expanding water needs. It further alleged that notwithstanding the 1931 allowance of 440 m.g.d., the City would by the year 1967 experience a water shortage and that from 1967 onward, its consumption and use of water would progressively increase to 1800 m.g.d.

The petition also alleged that in anticipation of its expected water supply requirements beyond the year 1967 the City had prepared plans for the development of the West Branch of the Delaware River at Cannonsville, New York, which upon completion within approximately fifteen years would increase the dependable safe yield of its water supply systems to 1800 m.g.d., and that this development was the most feasible and practical, and would not affect adversely the interests of the various States involved.

Finally, the petition alleged that the increase sought by the petitioner was just and necessary; that the plan of taking would be of great and lasting benefit

to all parties by reason of the release of more water during periods of particularly low stream flows under a new formula that was preferable to and would be substituted for the 1931 water release formula; and that New York State had approved of the City's plan, conditioned upon the Court's allowance of the increased diversion.

Cl. 3.012. The Answers of Pennsylvania and New Jersey to the Original Petition. The separate answer of Pennsylvania admitted the allegation that the City of New York had by the 1931 decree been allowed to divert 440 m.g.d. of Delaware River water subject to the qualification that the City had originally planned to divert 600 m.g.d., which quantity Special Master Burch found was excessive and had reduced to 440 m.g.d. in order to avoid serious injury, and the further qualification that the finding by the Special Master that the City's diversion should be limited to 440 m.g.d. was definite and final and was not one of the issues left open for future modification under the retained jurisdiction of the Court, which latter position was not pressed by Pennsylvania in view of this Court's order referring the petition to the Special Master.

The answer further admitted the allegation that the City's consumption and use of water had been increasing since 1931 but denied that it had yet reached a critical point; and averred that Philadelphia and southeastern Pennsylvania, whose consumption and use of water as well as population and industry had increased to an even greater extent, depended almost entirely on the Delaware River for their water supply.

The answer pleaded insufficient information to reply to the allegation that the dependable safe yield of the City's water system was presently 1120 m.g.d.; but

averred that such yield would be increased by 440 m.g.d. when the Delaware River reservoirs allowed under the 1931 decree were placed in operation, and that the City's use of water could be reduced approximately 200 m.g.d. by metering and other economies. It denied that the City could expect a severe and steadily intensifying water shortage about the year 1967 onward.

The answer denied that the Cannonsville plan was the most feasible and practical; and averred, on the contrary, that any water needs of the City could be supplied feasibly, practically and more economically from the Hudson River, and that this available source of supply could be readily and efficiently integrated with, and form a natural extension of, the existing water supply facilities.

The answer averred that because the reservoirs now being built had not as yet been put into operation, the release formula contained in the 1931 decree had not as yet been put to a test and the proposed modification thereof was premature; that the proposed substituted formula was substantially that contained in certain reciprocal legislation which did not become effective; and that without further information Pennsylvania was unable to admit or deny the allegation that the proposed substituted formula was preferable and would release more water. It further averred that the 1931 formula had been formulated to meet the present and reasonable future water needs of all three States; that the petition did not on its face show that any change therein was presently necessary; and that the 1931 decree had imposed a duty upon every diverter of Delaware River water to participate in the protection of the entire river from any injurious effect of any diversion.

Pennsylvania's answer further averred that (1) the Commonwealth had the greater drainage area and was entitled to paramount consideration in apportioning the waters of the Delaware River; (2) the continued growth and prosperity of Philadelphia and southeastern Pennsylvania depended upon the waters of the Delaware River being available in adequate quantity and suitable quality for the future reasonable water needs and requirements of that area; (3) the Delaware River basin comprised a competitive water supply area of limited quantity, the waters of which must be fairly and equitably apportioned between the four bordering States in accordance with their present and reasonable future needs; (4) the allowance of 440 m.g.d. of Delaware River water to the State and City of New York did not constitute a prior appropriation and gave them no superiority of right over Pennsylvania and New Jersey in their enjoyment and use of the Delaware River and its tributaries; (5) the present comparative situation as between New York and Pennsylvania had not changed in favor of permitting a greater diversion to New York but rather indicated that a diversion of as much as 440 m.g.d. to another watershed should not have been permitted; (6) the allowance of an increased New York diversion of 360 m.g.d. would substantially injure Pennsylvania, its citizens and industries, and would prevent them from taking and receiving their fair and equitable share of Delaware River water, which share had been assured to the intervenor under the decree of May 25, 1931; and (7) by reason of such substantial injury, the State and City of New York should now be directed to meet any additional need for water from the available sources of supply in the intrastate Hudson River.

The answer of New Jersey was at first non-committal; but shortly after the filing of the Pennsylvania answer, the former was amended and took virtually the same position as that of Pennsylvania.

Sec. 3.02. Pre-Trial Negotiations. Formal hearings had been scheduled to begin in February, 1953, when, at a pre-trial conference before the Special Master in New York on January 26, 1953 it was disclosed that New York and New Jersey had for months been engaged in negotiations and had arrived at a "settlement" under which (1) New Jersey would consent to the "complete" diversion (*i.e.*, outside the Delaware watershed) by New York of 800 m.g.d. from the Delaware River and its tributaries under a new release formula known as the "Montague formula," and (2) New York would not oppose a complete diversion by New Jersey out of the Delaware River watershed of 250 m.g.d. from the Delaware River and its tributaries below the New York state line.

Pennsylvania requested and was granted time to study the terms of the New York-New Jersey agreement.

Subsequently, Pennsylvania notified counsel for New York and New Jersey that it could not accept and join in the New York-New Jersey agreement.

As to New Jersey, Pennsylvania declined to accede to a complete diversion outside of the Delaware River watershed of more than an average of 100 m.g.d. without compensating releases and conditioned its consent even to this diversion upon the enactment by New Jersey of legislation which would (1) revoke the compact of 1783 under which neither State could do anything in the main channel of the Delaware River which would interrupt navigation and (2) commit New Jersey to exercise the power of eminent domain in New Jersey for Pennsylvania's benefit under certain conditions if Pennsylvania should elect either or

both to build an impounding reservoir at Wallpack Bend on the main channel of the Delaware River or a diversion dam at Yardley, Pennsylvania, or Brookville, Pennsylvania, also on the main channel of the Delaware River.

Counsel for New Jersey agreed to these terms and undertook to have the necessary legislation enacted in May, 1953.

However, the legislation was not enacted until December 30, 1953 (Chapter 443 of the 1953 Public Laws of New Jersey, N. J. Exhibit No. 15); and, because Pennsylvania's position in the proceedings would depend upon the enactment or non-enactment of the New Jersey legislation, the formal hearings were postponed from time to time and (except for the appearance of one witness on October 19, 1953) did not begin until February 19, 1954.

Pennsylvania had imposed a third condition, namely, that its engineers and New Jersey's engineers should work out release formulae which would apply in the event a storage reservoir was constructed at Wallpack Bend or in the event that either Pennsylvania or New Jersey erected water works on the tributaries of the Delaware within their respective States.

After many weeks of negotiations, it was mutually agreed to abandon the effort to reach an agreement and to let the Supreme Court of the United States decide what the releases should be if, as and when either State should attempt to make a diversion within the watershed with releases unsatisfactory to the other.

The point of difference between the two States, which made a present agreement impossible, was that New Jersey insisted that a minimum flow must always be maintained at Trenton substantially in excess of the natural minimum monthly average flow of record, while Pennsylvania took the position that the primary use of the Delaware River and its tributaries is for water supply and that

inasmuch as southeastern Pennsylvania is solely dependent upon the Delaware River and its tributaries for future water supply, the Commonwealth could not agree at the expense of such supply to the maintenance of an artificial minimum height of the River at Trenton.

As far as New York was concerned, Pennsylvania acknowledged that as of the present time it could not show that New York's plan to divert into the Hudson River watershed an additional 360 m.g.d. and to make the releases complying with the Montague formula (as Pennsylvania then understood it) would damage Pennsylvania. However, Pennsylvania pointed out that its engineers were of the opinion that at some not too distant future date the Delaware River and its tributaries would prove inadequate to furnish water supply to southeastern Pennsylvania and southern New Jersey and to permit, at the same time, a diversion out of the watershed by New York City of 800 m.g.d. and by New Jersey of 100 m.g.d. Consequently, Pennsylvania stated that it would insist that if the present proceeding were to be resolved on the basis of the present rather than of the future and if Pennsylvania were not to object to this procedure, the amended decree of the Supreme Court must make it clear that Pennsylvania shall never in the future be estopped from asking that the New York diversion be reduced or even eliminated, notwithstanding the large expenditures to be made by New York for the construction of the Cannonsville Reservoir.

Coupled with the no-estoppel condition, Pennsylvania insisted that New York's diversion should again be stated not to be a prior appropriation and that paragraph 6 of the original decree should be incorporated in the amended decree. Pennsylvania also stated that it was going to insist upon the appointment of a River Master to administer the decree and for other purposes.

Sec. 3.03. The Amended Petition of New York City. On October 19, 1953, New York City asked and was subsequently granted leave of the Supreme Court of the United States to file an amended petition in which the State of New York joined.

In its amended petition, the City of New York substituted for the release formula set forth in its original petition the so-called Montague formula stating, however, that the releases made by New York should keep the level of water at Montague, New Jersey up to 1525 c.f.s.[5] prior to the completion of the Cannonsville Reservoir and up to 1750 c.f.s. thereafter "within practicable limits", and also qualifying its release agreements by stating that releases should never be required in excess of the capacity of the New York City release works.

Except for the averments regarding releases, the New York City amended petition was substantially the same as its original petition.

New York City appended to its amended petition the consent of New Jersey signed by its Attorney General to the granting of the prayer of the petition.

Sec. 3.04. The Answers of New Jersey and Pennsylvania to the Amended Petition. Pennsylvania filed an answer to New York City's amended petition, as also did New Jersey, notwithstanding its formal consent.

New Jersey's answer (paragraph 25) requested an "adjudication of its right to divert 100,000,000 gallons daily without compensation releases from the Delaware River watershed, as a part of its fair and equitable share of the waters of the Delaware River. Such diversion of 100,000,000 gallons daily shall be determined on a monthly basis, the maximum diversion on any particular day not to exceed 120,000,000 gallons."

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[5] c.f.s. is the abbreviation for cubic feet per second.

The diversion of 100 m.g.d. on an average monthly basis, the maximum diversion on any particular day to be 120 m.g.d., was the diversion upon which counsel for New Jersey and counsel for Pennsylvania had agreed prior to the passage by New Jersey of Chapter 443 of the 1953 Public Acts of New Jersey.

Pennsylvania's answer (paragraph 21) objected to the inclusion in the Montague formula of the expression "within practicable limits" and also to limiting the requirements of the formula by the capacity of New York City's release works.

Also (in paragraph 30), it insisted that if a modified decree be allowed, the decree should embody the following conditions:

a. The diversion by New York City should not be deemed a prior appropriation nor should any modified decree be construed as increasing New York's fair and equitable share beyond 440 million gallons daily.

b. Notwithstanding any expenditure made by New York City to construct the Cannonsville Reservoir and appurtenances, Pennsylvania's failure now to object should not estop her from requesting the Supreme Court of the United States to modify the decree in such a way as to prevent damage to Pennsylvania, including, if necessary, the complete discontinuance of the additional diversion for which New York City is now requesting authority.

c. The release formula set forth in paragraph 21 of the amended petition of the City of New York should be modified as requested in paragraph 21 of Pennsylvania's answer.

d. The Court, in its decree, would define the meaning of "the equivalent of 800 million gallons daily" to mean monthly averages not exceeding 800 million gallons daily.

e. The Court would appoint a River Master to police the use of the River, to see to it that the diversions are not exceeded and that the releases are made as ordered by the Court and to perform such other duties as the Court may direct.

f. The decree would repeat the substance of paragraph 6 of the decree of May 25, 1931.

Sec. 3.05. The Intervention of the State of Delaware. After the formal hearings began, the State of Delaware announced its intention to file an application for leave to intervene. This application was filed in the early part of April, 1954. The motion was granted by an order of the Supreme Court of the United States dated April 12, 1954, which referred the matter to the Special Master. Meanwhile, in order to avoid further delay and with the consent of all parties, Delaware had been permitted to present its testimony with the understanding that if its application to intervene should be denied, the testimony would be stricken.

Delaware's answer to the New York petition took substantially the same position as that of Pennsylvania so far as concerns the conditions upon which New York should be permitted to divert out of the watershed an additional quantity of water, and specifically alleged that the "future development of the Delaware River Basin within the borders of Delaware may require that whatever diversion or diversions which may be granted in these proceedings be amended or eliminated" (paragraph 23).

In answer to New Jersey, Delaware denied that any party had a historic right or priority to the use of the waters of the Delaware River. Since, however, Delaware was unable at this time to show the proposed diversion of New Jersey would result in substantial injury to

Delaware, the request of New Jersey to divert 100 m.g.d. without compensating releases was not opposed provided that any decree entered herein should contain a provision that such diversion would not constitute a prior appropriation.

ARTICLE 4

Solution of the Controversy by Scientific and Legal Techniques

Sec. 4.01. General Comments. In the first instance, the Special Master was confronted by the difference in result which might be arrived at if, on the one hand, the solution of the problem submitted to him was worked out solely by the logic and precedent inherent in the conventional processes of adjudication, or, on the other hand, by the empiric techniques of science. In a case arising under the original jurisdiction of this Court, it would appear that science should be the handmaid of law. And yet there were many good reasons to consider whether in a case involving the interests of so many communities and people law might not, without loss of dignity, be the handmaid of science. The Judicial Conference of the United States, acting through its committee to examine into the procedure governing complicated controversies has reported:

> "Your Committee submits as a procedure which may be helpful in the determination of disputed scientific or extremely technical facts of unusual complexity or difficulty, the submission of such questions, precisely stated and defined, to experts as special masters. An expert or a panel of experts in the field in which the disputed fact lies should be selected, either by agreement of the opposing parties or by the parties and the judge. The expert or experts thus selected should be designated as a special master or as special masters to act *en banc*. The disputed issue of fact should be submitted to him (including a panel as 'him') in writing. He should be empowered to hold hearings, to receive such evidence presented by the parties as he may deem relevant and material to the issue, to permit cross examina-

> tion, and otherwise to control the hearing so as to achieve the maximum expedition consistent with fair opportunity for the parties. The master or masters should make a written report, including basic findings and a conclusion upon the issue presented. This report should be received by the court as a special master's report under the Rules of Procedure, subject to exceptions, argument and the other established features of that procedure."[1]

The Special Master has come to the conclusion, as the result of his experience in the case at bar, that the fullest scope should be permitted to scientific experts in the shaping of issues and the preparation of the evidence to support them. However, the ability of members of the legal profession to analyze and organize issues, and to negotiate the differences existing between experts is so invaluable that in the opinion of the Special Master no reference should ever be made to special masters sitting *en banc,* unless at least a majority of the tribunal is constituted of lawyers. In this case the Special Master had the co-operation of eminent hydraulic engineers. However, had it not been for the counsel, enlisted by each party to the cause, this proceeding could not have been initiated, developed, and terminated so expeditiously.

Sec. 4.02. Scientific Techniques. Expert witnesses for the parties adduced a mass of clear, well-organized testimony and scientific exhibits. The science of hydrology is well developed in this country and much is owed to the early, tireless, and unending efforts of the United States Geological Survey. Each of the issues in the pleadings was highlighted by abundant evidence. Upon one point, however, all evidence was uncontroverted—that in the

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[1] *Procedure In Anti-Trust and Other Protracted Cases: A Report Adopted by the Judicial Conference of the United States,* September 26, 1951, pp. 32-3.

course of a calendar year the Delaware River and its tributaries produce more than enough water to meet the present additional requirements of the City of New York, as well as the present requirements of the citizens of New Jersey, Pennsylvania and Delaware, if the surplus waters of winter and spring are stored for later release. In this connection it is important to keep in mind that the formula by which the City of New York will eventually take 800 million gallons of water per day from the Delaware River does not involve withdrawal of so many gallons *ex* River *per calendar day,* but the withdrawal of those gallons *ex* Reservoir *per calendar day.* The water reserves necessary for such daily withdrawal are in turn built up by a seasonal take of billions of gallons *ex* River when water is plentiful; and the formula incorporated in the Amended Decree will require releases *ad* River *ex* Reservoir to maintain the summer River at a higher flow.

Sec. 4.03. Legal Techniques—In Theory.

Cl. 4.031. The Interests Involved. A great jurist [1] has classified the interests which it is the purpose of the law to secure as individual, social and public. Individual interests are those reasonable expectations of self-expression and self-protection which a single human being asserts, simply as such, with regard to his personality (physical person, honor and reputation, privacy and sensibilities, and belief and opinion); domestic relations; and substance (property, freedom of industry and contract, promised advantages, and advantageous relations with others). Social interests are asserted expectations in title of society as a whole or of established social groups of their stake in the general security (safety, health, peace and order, secu-

[1] Roscoe Pound, *Outlines of Lectures on Jurisprudence,* Second Edition (1914), pp. 56-60; and Fifth Edition (1943), pp. 96-112.

rity of transactions, and security of acquisitions); security of social institutions (domestic, religious, political, and economic); general morals; conservation of social resources; general progress; and the individual life. Public interests are the expectations asserted in title of a politically organized society—a state or nation as a juristic person—in its personality and substance; and as the guardian of social interests. Clearly, although both individual and social interests will be affected by the solution of the present controversy, it is only by virtue of their implication as part of the public interests involved that they have any standing for consideration. The interest of a sovereign state or nation in its own integrity involves not merely its stand against conquest from without and breach of the peace from within; its power to tax in order to carry on its administration and public works and to protect and further the social interests of which it is guardian; but as well its interest in the conservation and protection of its natural resources, particularly to the extent they may have an effect upon its future economic and political progress.

Cl. 4.032. The Available Sanctions. Generally speaking, adjudication is the sanction best adapted to the settlement of conflicting or overlapping individual interests, particularly where such interests do not also involve social interests. Legislation is the sanction by which we enforce the settlement of conflicting or overlapping social interests. In the case of public interests, however, we are still in process of a long search for appropriate and up-to-date sanctions; for the main problem of sovereignty has been the development of a sanction strong enough to secure its integrity. Thus, the sanction most relied upon throughout civilization—war—has in the course of time been varied by the

military federation; a consensual league of states; adjudication by an international or federal tribunal; coextensive legislation on the part of the legislatures of the two or more sovereigns involved; inter-sovereign negotiation; inter-sovereign negotiation buttressed by coextensive legislation of the sovereigns involved; and, finally, negotiation buttressed by adjudication on the part of the courts of such sovereigns. While in the case of individual interests the progress of the legal rights and attendant sanctions which secure them has been "from Status to Contract,"[2] an almost similar development from the force of might to the psychological acceptance of the governed has attended the development of the sanctions which secure public interests.[3]

Cl. 4.033. Adjudication by a Federal Tribunal. Article 3, Section 2, of the Constitution provides that the judicial power shall extend to controversies between two or more states and thus points primarily to the settlement of such controversies by the sanction of adjudication. That adjudication so rendered has not always been attended by the sanction of the psychological acceptance of the sovereign parties involved is illustrated by the result of the decision of this Court in the *Tidelands Oil Cases,*[4] and the subsequent reversal of that adjudication by the Federal Congress[5] as the result of negotiation buttressed by legislation. It still remains to be seen whether the

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[2] Maine, *Ancient Law,* page 170.

[3] Jellinek called this the "social-psychological guarantee". See his *Die Sozialethische Bedeutung von Recht, Unrecht und Strafe,* Second Edition (1908); see also Pound, *Outlines of Lectures on Jurisprudence; Social-Psychological Limitations upon Enforcement of Legal Precepts,* Fifth Edition (1943) p. 114.

[4] *United States* v. *Louisiana,* 339 U. S. 699 (1949); *United States* v. *Texas,* 339 U. S. 707 (1949).

[5] *Submerged Lands Act,* Pub. Law 31, 83d Congress, Ch. 65, 1st Session [H.R. 4198], 43 U.S.C.A. §§1301 et seq. (1953).

latter technique will bring any more permanent results in that case than did adjudication.

Cl. 4.034. Inter-Sovereign Negotiation. Although negotiation (which has not been buttressed by co-extensive legislation or by adjudication) is certainly calculated to evoke the psychological acceptance of the negotiators, and possibly of the executive departments to whom such negotiators are responsible, the experience both of our states and of the Federal Government is that inter-sovereign negotiation, alone, does not possess sufficient sanction to establish firmly an inter-sovereign pact. Particularly in the United States where the status and function of the legislature and the courts have become so paramount in the public mind, is this true.

Cl. 4.035. Inter-Sovereign Negotiation Buttressed by Coextensive Legislation. Long after the entry of the original Decree of this Court in 1931, efforts were initiated between the four sovereign states involved to obtain sanction of the next step in the development of the Delaware River through the process of negotiation buttressed by coextensive legislation. The Interstate Commission on the Delaware River (Incodel), established in 1936, with representatives from the States of Delaware, New Jersey, New York and Pennsylvania, developed a comprehensive plan for the development, utilization, control and conservation of the water resources of the Delaware River Basin. The plan called for a development in two stages at an overall cost of $850,000,000 by the four states involved, although two of these states—Delaware and Pennsylvania—were not yet in any need of availing themselves of the additional water supply which would be produced by the plan. The Incodel plan further

ran counter to realistic possibilities in requiring the coextensive enactment of substantially identical legislation incorporating the plan by the legislatures of the four states involved. In 1951, Delaware adopted legislation in the exact language recommended by Incodel.[6] In the same year, New Jersey also acted,[7] but the statute made substantial changes in the proposed compact provisions recommended by Incodel. New York passed legislation in 1952,[8] but the Act made further substantial changes in the proposed compact provisions in addition to those already made by New Jersey. The variations in the legislation enacted by the three States still exist today. Pennsylvania has not adopted any legislation, whatever; and the Pennsylvania Water Resources Committee has in substance recommended disapproval of the Incodel Plan. The Acts passed by Delaware and New Jersey contain in substance the following provision of the New York Act:

> "§4. *Effective date of this act.* The provisions of this act shall become effective immediately upon final enactment; but the Governor shall not enter into the compact herein set forth until the State of New Jersey and the Commonwealth of Pennsylvania shall have passed a substantially similar act embodying the said compact between at least the States of New Jersey, New York and the Commonwealth of Pennsylvania."

No interstate compact is, therefore, in existence.[9] And the long effort to develop the river through negotiation buttressed by coextensive legislation on the parts of the legislatures of the four sovereign States involved was unsuccessful.

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[6] 48 Del. L., C. 276.
[7] L. 1951, C. 283.
[8] L. 1952, C. 701.
[9] See Statement by The Honorable Edward L. Ryan, Assistant Attorney General of the State of New York, Pa. S. M. 31-32.

Cl. 4.036. Negotiations Buttressed by Adjudication. As result of the foregoing brief survey, it would appear that the resort, in the instant proceeding to negotiation buttressed by an adjudication on the part of this Court is justified. Moreover, the decisions of this Court have for sometime approved similar procedure, the last time in the case of *Nebraska* v. *Wyoming*[10] in which the adjudication of water rights was also involved. In this connection it is particularly important to keep in mind that the ordinary citizen is much more likely to trust a court of equity than a court of law or a legislature, because of the continuing jurisdiction over a controversy which a court of equity may retain and the opportunity thus afforded to correct supervening inequities. In this respect the action of this Court in 1931 is particularly to be kept in mind. It added to the Decree recommended by Special Master Burch the following paragraph:

> "6. Any of the parties hereto, complainant, defendants or intervener, may apply at the foot of this decree for other or further action or relief, and this Court retains jurisdiction of the suit for the purpose of any order or direction or modification of this decree, or any supplemental decree that it may deem at any time to be proper in relation to the subject matter in controversy."[11]

Without the experience of the parties under Paragraph 6 of the 1931 Decree and the insertion of a similar paragraph in the Amended Decree, the new formula contained in the latter would never be able to obtain the psychological acceptance of the executive

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[10] 345 U. S. 981 (1952).

[11] 283 U. S. 805,807.

departments, legislatures, official representatives, witnesses and citizens of the parties involved.

Sec. 4.04. Legal Techniques—In Practice.

Cl. 4.0401. The Techniques Employed. Because both the nature of the public interests involved in this proceeding, and the theory of the legal techniques to be used in implementing them, point to the use of negotiation buttressed by an adjudication on the part of this Court, counsel representing the parties, determined at an early date to resort to modern techniques of pre-trial procedure, rather than the more conventional and traditional methods of trial and adjudication in their attempts to arrive at a solution. Inasmuch as such pre-trial techniques have been successful in presenting to the Court an Amended Decree, it would appear to be proper to comment upon the principal techniques employed. In this respect, both counsel and the Special Master had the advantage of the recommendations contained in the Report adopted by the Judicial Conference of the United States on September 26, 1951,[12] distributed by the Administrative Office of the United States Courts. To the extent that the organization and subject-matter of such Report of the Judicial Conference permits, the same will be followed in this Report of the Special Master.

Cl. 4.0402. Pre-Trial Conferences. From the first hearing, held on July 29, 1952, until the beginning of the introduction of evidence in the case on the part of the City and State of New York, on October 15, 1953, pre-trial techniques of all varieties were employed by

[12] *Procedure in Anti-Trust and Other Protracted Cases.*

counsel and their consulting engineers in an attempt to work out a solution of the present controversy. These pre-trial techniques were continued after October 15, 1953, in light of the difficulties encountered in obtaining passage of the Repealer Act by the State of New Jersey, the subsequent complications involved in the Petition for Intervention by the State of Delaware, filed early in April, 1954, and the action taken to admit that State as a party.

Cl. 4.0403. Analysis of Prior Proceeding and Present Issues Made by Special Master. At the first pre-trial hearing, held on July 29, 1952, there was submitted to all counsel an "Analysis of Prior Proceeding and Present Issues Made by Special Master Prior to Commencement of Hearings," 26 pages in extent. This Analysis was submitted with the stated objective of acquainting counsel with the then existing reaction of the Special Master to the 1931 decision of this Court, and the issues raised by the pleadings in the 1952 proceeding. It was felt this step would tend to eliminate the blind and unavailing effort made by counsel in other cases to "educate" the Court upon the material issues in the case. It was also felt such an Analysis on the part of the Special Master would serve to give direction to the arguments and efforts of counsel.

Cl. 4.0404. Memoranda Submitted in Answer to Analysis of the Special Master—Trial Briefs. Acting upon the suggestion of the Special Master, counsel, in turn, furnished him with memoranda in which they pointed out their various points of disagreement with the Analysis made by the Special Master. Such memoranda, which were, of course, in the nature of trial briefs, were exchanged with all opposing counsel.

The exchange between the court and counsel thus effected brought all the issues into immediate and effective focus. Counsel became advised of the points upon which the Special Master required further education; the Special Master in turn was placed in possession of points upon which the position of counsel promised to be difficult. The procedure adopted was, in the opinion of all who participated therein, far more efficient in giving direction and momentum to the proceeding than the usual procedure of "opening statements" with practically no comment or reaction from the court.

Cl. 4.0405. Physical Mechanics of Record. At the first hearing, it was determined to try to avoid the expense and delay involved in the ultimate printing of the record and exhibits preparatory to their reference with the Report of the Special Master to the Supreme Court. The Reporter was accordingly instructed not to prepare the copies of the testimony and exhibits by mimeographed typewriting; but to prepare all testimony with executive type (bold faced capitals and lower case letters of large type) on paper 8 by 10½ inches in size. Parties were also instructed to prepare exhibits upon paper of the same size, except that large maps and other documents were to be reduced by either the photostatic or offset process to the size of 8 by 10½ or were to be folded. This particular size of paper permits binding so that the bound volume can eventually find space on the conventional 11 inch law-library shelf. Exhibits were introduced in sufficient number so that the parties and all their counsel and engineers might have original duplicate copies to preserve against the time when this proceeding might again be reopened in this Court.

The official reporter was instructed to retain all stencils made by him so that upon the completion of the case further copies of the entire record, including exhibits, would be available for prompt and inexpensive filing with this Court. These instructions have been adhered to resulting in the filing with the Clerk of this Court, within five weeks of the completion of the testimony, of twelve bound volumes of all the testimony and exhibits in not merely highly legible form, but with substantially all exhibits in their original format (even though reduced in size) bound or housed conformably with the verbal testimony.

Cl. 4.0406. Exchange of Exhibits. Counsel agreed to exchange the exhibits prepared to support the issues sponsored by them at the earliest opportunity. In the case of the more important technical exhibits, many were brought to the hearing room as early as December 3, 1952. To the extent that such exhibits engendered counter-exhibits, the counter-exhibits were made available to opposing counsel far in advance of the date of introduction.

Cl. 4.0407. Preparation of Exhibits. All exhibits, when reduced or folded to proper size, were transmitted to the Official Reporter, who authenticated the same, marked them for identification, bound or housed them in appropriate temporary volumes, and transmitted them to the parties.

Cl. 4.0408. Stipulations. The parties availed themselves of stipulations directed particularly at the applicability or non-applicability of the usual rules of evidence, the way in which exceptions were to be taken, the right to cross-examine and recall witnesses, and many similar procedures which eliminated the usual cumbersome techniques attendant on

the conduct of a complicated hearing. As result of these stipulations, and the further wholehearted cooperation of counsel and expert witnesses in expediting the hearings, counsel finally withdrew all objections to testimony with the sole stipulation that counsel be permitted to comment on testimony considered inadmissible or irrelevant, and as to its weight. At the beginning of the hearings the entire emphasis in the pre-trial conferences was on procedural matters; from there it progressed to consideration and discussion of the substantial issues; and in due course the pre-trial techniques were addressed to the determination of solutions of the issues and the way in which such solutions were to be worded.

Cl. 4.0409. Advance Exchange of Testimony. As in the case of exhibits, the testimony of all witnesses in the proceeding was prepared in writing and circulated weeks in advance of the hearing at which it was to be introduced. Generally, when previously circulated testimony is introduced, each witness is subjected to cross-examination. In the instant proceeding, it is of great interest to note that no expert witness was cross-examined. In each instance in which it was sought to controvert the direct testimony of an expert, one of the opposing witnesses submitted similar narrative testimony in opposition. The agreement upon this technique succeeded in eliminating not a little in the way of overstatement, and in implementing the clear illumination of the exact points on which there was difference.

Cl. 4.0410. Inspection of the Delaware River. In the 1929 proceeding, a six-day inspection of the Delaware River was held at the *conclusion* of the testimony. In the present proceeding, it was deemed advisable to

hold the five-day inspection of the River at the *beginning* of the hearings—namely, from August 5 to 9, 1952. During this inspection tour, the institution of conferring directly with the expert witnesses was inaugurated. Such conferences were held (a) between expert witnesses and opposing counsel; (b) between opposing expert witnesses; and (c) between expert witnesses, counsel, and the Special Master. They led to acquaintance with the background and personalities of all concerned in the case, and became of inestimable value in the subsequent pre-trial negotiations.

Cl. 4.0411. Plan of Trial. A time schedule for the hearings was worked out immediately after the inspection of the River. Because of the many difficulties involved in the proceeding, neither the original nor any subsequent time schedule was observed. The case was fraught with so many considerations of the interests involved, the media through which negotiations were conducted, and the various facets of public policy to be observed, that nothing proceeded according to plan. It is, of course, worthy of note that more battles have been won by leaders capable of improvisation, than by those who have proceeded according to plan.

ARTICLE 5

Statements of the Contentions of the Parties

Sec. 5.01. The Purpose of the Statements. The Order of the Supreme Court referring this proceeding to the Special Master directs him "to report to the Court with all convenient speed his recommendations in respect of the amendment of the Decree, if any." Such Order neither requires nor authorizes the Special Master to make findings of fact or arrive at conclusions of law. It is therefore without the province of this Report to make any statement of facts *qua* facts. However, the written testimony and the exhibits are voluminous, and the issues raised by the pleadings, testimony and exhibits are vital and in many cases diverse. It is consequently felt that understanding of the Amended Decree herewith submitted may be greatly facilitated by a Diagrammatic Statement of the Contentions of the Parties, a Summary Statement of the Contentions of the Parties, and a Detailed Statement of the Contentions of the Parties. These three presentations follow next in order in this Report. It remains only to point out that all three of such presentations relate to the *contentions* of the parties, and are in no sense to be construed as *findings of fact,* or as an acceptance by any party of the contentions of any other party. Throughout, it is to be remembered that inasmuch as no authority has been conferred by the Order of Reference upon the Special Master to make findings of fact or arrive at conclusions of law, no pretense at performing either of those functions is to be read into any or all of such three Statements. On the contrary, such statements are to be considered merely as diagrammatic and factual indices to the testimony and exhibits, and in case of any conflict between such two sources and the contentions set forth in such three Statements, such sources are to be considered para-

mount. In other words, those who may hereafter consult this Report are referred to the testimony and exhibits if they wish to obtain not merely the exact contentions of the parties, but the ultimate facts adduced in evidence by them.

Sec. 5.02. Diagrammatic Statement of the Contentions of the Parties. In connection with the first witness testifying for the City of New York, a large basic map, size 45 inches by 66 inches, was introduced indicating in color the hydrological improvements constructed by the City of New York to produce its water supply (City's Exhibit 7; Huie, p. 23). At the request of the Special Master, this Exhibit was thenceforth used as the basic geographical Exhibit of all the parties; and from time to time thereafter New Jersey, Pennsylvania and finally Delaware added to City's Exhibit 7 the water resources and improvements referred to by their respective witnesses and in their Exhibits. City's Exhibit 7 thus became a composite diagrammatical exposition of the surface water supplies of the communities lying in the Delaware River Basin, both existing and contemplated. The Special Master proposed that a diagrammatic chart be prepared showing the location of such surface water supplies; the watershed areas involved in square miles; the storage capacity of the installations involved in billions of gallons; and the Record references to support such data. This Chart was in turn annexed to a small replica of City's Exhibit 7 and finally introduced by the Special Master as Special Master's Exhibit X on April 15, 1954 (Pa. S. M. 48-50). It is appended to this Report at page 120, the reduced map (being a small replica of City's Ex. 7 as supplemented by witnesses for New Jersey, Pennsylvania and Delaware) being annexed so that it may be unfolded and used by the Court as a diagram-

matic guide in reading the next two Sections of this Report. It should again be noted, however, that inasmuch as Special Master's Exhibit X was prepared through the cooperation of all the parties at the request of the Special Master, the facts and conclusions therein set forth are subordinate in all respects to the paramount status of the actual testimony of witnesses and exhibits set forth in the Record.

Sec. 5.03. Summary Statement of the Contentions of the Parties.

Cl. 5.031. Contentions of New York.*

It. 5.0311. The Need. The need of New York City for an additional water supply is urgent. Its presently authorized sources provide no adequate reserve. The selection of the West Branch of the Delaware River has been authorized by City and State regulatory authorities, subject to the approval of this Court, and is not arbitrary or beyond the freedom of choice of the City.

It. 5.0312. The Source. The proposed Cannonsville Reservoir is the most suitable source of such supply, because it will provide a necessary reserve and be adequate until near the end of the present century; because it is a gravity supply easily integrated with the existing system of the City; and because of the high quality of this upland source.

It. 5.0313. The Effect of the Proposed Plan of New York. The proposed diversion will cause no damage because the necessary impounding in the reservoirs of the City will be confined mainly to periods of high flow in the Delaware River. The plan of the City includes sufficient storage capacity to make releases from its reservoirs for the benefit of the lower River at times of low flow when most needed. The effect on the salinity in Delaware Bay is slight but beneficial. The effect on the salinity in the tidal reaches of the Delaware River is beneficial and substantial. The effect on the oyster industry is very slight but

* All *contentions of New York* referred to in this Report are actually contentions of The City of New York concurred in by the State of New York. The shorter denomination has been used for purposes of titular uniformity and contrast.

in any event beneficial. The plan at no time will cause damage to such uses as navigation, water power, recreation, industry and agriculture, and will result in substantial benefits at times of low flow. The releases under the New York plan will benefit any and all future water supply developments on the Delaware River by the lower riparian states.

It. 5.0314. River Master. Although a River Master is not necessary at present, the appointment of the Chief Hydraulic Engineer of the United States Geological Survey as such may be acceptable to New York.

Cl. 5.032. Contentions of New Jersey.

It. 5.0321. The Need. New Jersey will shortly have increased water needs for substantial quantities, and such needs for additional supplies should take precedence over diversions or appropriations based upon quality.

It. 5.0322. The Source. Aside from minor undeveloped intra-state sources, New Jersey must obtain its additional supplies from the Delaware or its tributaries.

It. 5.0323. The Effect of the Proposed Plan of New York. With the exception of possible damage to the oyster industry in the lower Bay, New Jersey foresees no material damage because of the accomplishment of the New York Plan and anticipates certain advantages therefrom.

It. 5.0324. River Master. New Jersey has no objection to appointment of a River Master by the Supreme Court.

Cl. 5.033. Contentions of Pennsylvania.

It. 5.0331. The Need. Pennsylvania will, in the not too distant future, need additional water supply in large quantities from the Delaware River.

It. 5.0332. The Source. Southeastern Pennsylvania within the watershed is wholly dependent on the Delaware River as its future source of water supply.

It. 5.0333. The Effect of the Proposed Plan of New York. The water needs of the inhabitants and industries of Pennsylvania within the watershed will, in the future, be harmed and restricted by New York's proposed diversion. Pennsylvania denies absolutely the claim of New York that the proposed diversion will result in consequential benefits for the present and in the future.

Pennsylvania urges that if any modification of the 1931 decree be granted, it be made clear that the authorized diversions shall not constitute prior appropriations and that if Pennsylvania does not object to the modification of the decree on the basis of the present rather than the future, there shall be no estoppel against her at any time in the future notwithstanding any expenditures made by any party pursuant to the modified decree.

The Montague formula, as set forth in the amended petition, is unsatisfactory. The basic rate of release should be fixed and not applied "within practical limits." The words "equivalent of" preceding the various rates of release should be defined. The basic rate should be mandatory and not be reduced to any extent because of the capacity of the New York City release works.

It. 5.0334. River Master. Pennsylvania strongly urges the immediate appointment of a River Master

to administer any modified decree and to perform such duties as are specifically set forth in the decree.

Cl. 5.034. Contentions of Delaware.

It. 5.0341. The Need. The State of Delaware makes no potable use of the waters of the Delaware River, but does claim a substantial interest in such waters for industrial, wild life, estuarine and recreational purposes.

It. 5.0342. The Source. Delaware's only source of water for all uses is the Delaware and its tributaries.

It. 5.0343. The Effect of the Proposed Plan of New York. The proposed diversion by New York City will seriously injure and damage the State of Delaware. The Montague Release Formula, while more beneficial to the Lower River than the 1931 Release Formula, will not benefit Delaware if there is any subsequent diversion by New Jersey or Pennsylvania in addition to the New York City diversion. No appropriation or diversion of waters by any of the states must be deemed a prior appropriation, nor indicative of a right to the waters of the Delaware, superior to the rights of the State of Delaware.

It. 5.0344. River Master. The Decree of the Court should appoint a River Master to administer the provisions of the Decree.

Sec. 5.04. Detailed Statement of the Contentions of the Parties.

Cl. 5.041. The Scope of the Section. This section will attempt to set forth in some detail the contentions of the parties with respect to (a) the necessity for developing new sources of water supply, (b) the avail-

able sources of water supply, (c) the effects of the proposed New York plan, and (d) the appointment of a River Master. In many cases the statements are taken verbatim from the narrative testimony of witnesses or from briefs of counsel. The four main headings of contentions observed in Section 5.03 have been followed in this section and its subdivisions.

Cl. 5.042. The Need.

It. 5.0421. Contentions of New York.

The severe drought of 1949-1950 emphasized the urgent necessity for New York City to develop an additional source of water supply to supplement its Croton and Catskill supplies and those developments in the Delaware River watershed which were authorized by the Court's Decree of 1931 and are now nearing completion.

After a comprehensive study, the Board of Water Supply recommended that the City proceed to develop the West Branch of the Delaware with a dam and reservoir near Cannonsville, to be interconnected by tunnel with the City's Rondout reservoir (Huie, 12-13). The City's Board of Estimate authorized the Cannonsville project and directed that the necessary steps be taken toward obtaining the consent of the Court for a further development of the Delaware water supply system (City Ex. 3). The project was approved by the New York State Water Power and Control Commission subject to approval by this Court (City Ex. 4).

During the water shortage of 1949-1950, the City of New York obtained permission from the State Water Power and Control Commission to tap the main Hudson River near Poughkeepsie as an emergency supply (City Ex. 4; Special Master's Ex. X, *infra*, p. 120).

In this proceeding the selection by New York of a Delaware supply at Cannonsville has been questioned in view of the City's proximity to the unlimited supply of the Hudson River and the ease with which it can secure a tremendous volume of water from that river. While the Hudson supply was approved as an emergency measure by the State Water Power and Control Commission, it was not approved as a permanent source of supply (City Ex. 4).

The City contends that its choice of the Delaware is not arbitrary or beyond New York's freedom of choice (see the opinion of Mr. Justice Holmes in the 1931 Proceeding, 283 U. S. 336, 345).

The City's anticipated need after 1965 is the basic reason for its application to amend the decree. Inasmuch as the planning and active construction of a major source of supply must be started many years before the anticipated need becomes effective, it is imperative not only to meet the anticipated need but also to provide a reserve supply as a safeguard in severe droughts or other emergencies (Kennison, 215-217).

Table 3 of City Ex. 5 contains various methods of forecasting the future population of the City. An average of the four methods, using the estimates of minimum increase contained in Column (7) of Table 3, results in a population of 8,154,000 in 1960 and 8,373,000 in 1970. The City contends that its estimated increase of population is a truly conservative estimate (City Ex. 5, Fig. 6).

The per capita consumption of water in the City is estimated to increase to 160 gallons daily by the year 1965. The highest per capita consumption was 150 gallons per day in 1948. During the severe drought of 1949 and 1950, per capita consumption was reduced

to 121 gallons per day and total consumption to 982 m.g.d. Since then consumption has increased to 1140 m.g.d., in 1953. New York contends that its estimate of per capita consumption in 1965 of 160 gallons per day is in conformity with present and past trends and is a conservative estimate (Kennison, 270 B; City Ex. 5, Fig. 5, Tabs. 6, 11).

Thus, it is estimated by the City that the total consumption for the City proper in 1965 will be 8,260,000 (population) x 160 (gallons per capita daily) = 1321 m.g.d. To that figure the City contends that there must be added the supply required for outside communities, such as Westchester and Nassau Counties, estimated as an additional 65 m.g.d. in 1965. By law the City is required to supply water to several counties in the State, including Westchester and Nassau. L. 1905, ch. 724; L. 1939, ch. 273. This will mean a total consumption of 1386 m.g.d. in the year 1965.

To meet that consumption the City contends that its dependable yield in 1965 will be 1460 m.g.d., based upon a diversion of 440 m.g.d. from the Delaware supply, and if its present petition is granted the yield will be 1510 m.g.d., based upon an authorized diversion from the Delaware tributaries of 490 m.g.d. Thus, the City contends its margin of safety between estimated demand and dependable yield is far from conservative. A sufficient reserve is a vital matter to the City's more than eight million people (Kennison, 217).

It. 5.0422. Contentions of New Jersey. The present water consumption of Northern New Jersey is 418 m.g.d., and the safe yield of its presently developed supplies, in that area, is 435 m.g.d., of which approximately 35 m.g.d. is from the Delaware River.

Due to the increases in population and industry which have already taken place, and the estimates of increases in population and industrial development in Northern New Jersey, the estimated demand for water in that area will be 750 m.g.d. in the year 2000 (Sherman, 1318).

Its presently undeveloped intrastate supplies of available water sources will no more than offset the present supplies which may have to be abandoned.

New Jersey is taking all possible precautions to protect its water resources by sound conservation measures and, as a consequence, no margin of safety exists in its present water resources (Critchlow, 1015-1017).

Additional sources of supplies of approximately 358 m.g.d. will be necessary by the year of 2000 to meet the estimated needs of North Jersey, and the major portion of such additional supply will have to be from the Delaware River and its tributaries (Sherman, 1318).

New Jersey's present and estimated future needs should give it priority in satisfying its needs for quantity of water over those who desire to divert from the Delaware River based upon the desire for better or improved quality (Sherman, 1320).

The right to all existing uses of the waters of the Delaware River, and its tributaries, in the manner and at the locations presently exercised by municipalities or other governmental agencies, industries or persons, in the Delaware River watershed in the State of New Jersey, should be preserved and protected.

In preserving and protecting the rights of the parties in this case to the presently exercised uses

of the Delaware River, and its tributaries, no modification, change or increase in such uses which shall unduly damage any of the parties should be authorized.

It. 5.0423. Contentions of Pennsylvania.

Pennsylvania first produced evidence regarding the present and estimated future population and industrial development of Philadelphia and southeastern Pennsylvania and its present and estimated future water consumption and needs. Three witnesses testified on this subject.

President LaBrum of the Chamber of Commerce of Greater Philadelphia and past Chairman of the Greater Philadelphia-Delaware-South Jersey Council testified regarding (a) the population growth and industrial expansion, past, present and future, of Philadelphia and its eleven-county metropolitan area, and (b) the Port of Philadelphia and its increasing export and import trade (LaBrum, 2000-2039).

He stated that the metropolitan Philadelphia area is the fastest growing industrial and manufacturing area in the United States. Its industries are unusually highly diversified with 8100 different manufacturing concerns and 52,937 wholesale, retail and service establishments. Eighty-seven percent of all the different types of industry in this country are located in it (LaBrum, 2005-2009).

He presented Pennsylvania Exhibits Nos. 200-203 to show (1) the area's tremendous growth in manufacturing employment and in value of the manufactured products, and (2) its post-war expenditures in capital improvements exceeding five billion dollars (this includes only outlays of over five million dollars) (La Brum, 2008-2017).

He pointed out that the population growth of the metropolitan Philadelphia area is the highest in the United States percentagewise (Pa. Exs. 204-207). Its 1950 population was 4,169,216. Its estimated 1960 population is 5,064,600. In 2000 its population should have again doubled to 10,200,000 (LaBrum, 2017-2022).

LaBrum stated that the Port of Philadelphia and its import and export commerce is growing tremendously and faster than that of New York City (Pa. Exs. 208-210). It is the largest inland port in the country with splendid cargo handling facilities and a superb network of connecting railroads and highways. It does not require lighterage and is free of destructive salt water marine life by reason of its fresh water. During World War II, Philadelphia handled from 15 to 20% of all goods moving in and out of the United States. A Port Authority was created in 1952 by New Jersey and Pennsylvania (LaBrum, 2022-2031).

LaBrum throughout his testimony emphasized that the expansion and growth of the metropolitan Philadelphia area had in the past depended and would in the future continue to depend upon a proper allocation of an adequate supply of Delaware River water; and that its resultant future expansion and growth will require and use water in quantities far beyond that presently used or estimated. The five Pennsylvania counties in the area alone withdrew 2736.3 m.g.d. of water from the river for municipal and industrial use. He voiced the deep concern of the Chamber of Commerce of Greater Philadelphia lest the proposed New York diversion of 800 m.g.d. might jeopardize or throttle the growth and development of population and industry within the eleven-county area; and the belief that any diversion outside the watershed must be subordinated to the present

and reasonable future water needs of the people and industries within this area (LaBrum, 2003-2004, 2022-2035).

The second Pennsylvania witness, Water Commissioner Baxter of the City of Philadelphia, described its municipal water supply system, covering an area of 130 square miles. According to the 1950 census, Philadelphia's population was 2,071,605. He estimates it will be 2,400,000 by 2000 A. D. Future population increase inside the City, as contradistinguished from the metropolitan area of Greater Philadelphia, is seriously restricted because of its boundary limitations. Philadelphia consumed 359 m.g.d. of water in 1950, which was taken equally from the Schuylkill and Delaware Rivers. He estimates its 2000 A. D. requirements at 516 m.g.d. Its average consumption was 187.5 gallons per capita daily (g.c.d.) in 1952, and he estimates it at 215 g.c.d. for 2000 A. D. (Baxter, 2040-2045).

He stated that both the Schuylkill and Delaware River sources of water supply were presently affected by industrial and sanitary wastes and had to be treated in order to eliminate undesirable taste and odors and comply with Federal and State bacterial standards. Both sources of supply will have to be abandoned at some future date. The City of Philadelphia wants assurance that an upland Delaware River of good quality will be available, when needed; and believes that it has a prior right to such waters in a sufficient quantity to meet the future water needs of its population and industries. This right transcends the water needs of municipalities and industries beyond the basin (Baxter, 2045-2048).

Baxter concurred with the view of the Pennsylvania engineers Greeley and Ryder (whose testimony will be reviewed later), that water supply comes first (Baxter,

2063, 2093, 2130). He thinks that adequate stream flow regulation should be a part of any river development; and that the New York plan of impounding and release does not provide a permanent solution of the water problems of the Delaware River watershed. The interim appointment of a river master by the court would in his opinion be advisable until the creation of an interstate agency, which the City of Philadelphia believes will be a sound and permanent solution of the over-all problems of the Delaware River (Baxter, 2048-2051).

The third Pennsylvania witness, Samuel A. Greeley of Chicago, testified that the population in southeastern Pennsylvania and southern New Jersey for the year 1950 totaled 3,596,637. He estimates that it will probably be 6,371,000 by 2000 A.D. Their water needs and consumption were 495 m.g.d. in 1950, which he estimates will be 1265 m.g.d. by the year 2000. Their average daily per capita consumption in 1950 was 140 g.c.d., which he estimates will increase to 200 g.c.d. by the year 2000. The g.c.d. consumption of the area compares favorably with that of other large American cities. The foregoing statistics do not include water used for cooling and condensing within the area (Greeley, 2065-2067).

He estimates that the population of the local southern New Jersey area with its 514 square miles will in the year 2000 be around 19% of the estimated total population of 6,371,000 for the entire metropolitan Philadelphia area, and will then consume 278.3 m.g.d. or about 22% of the total estimated consumption of 1265 m.g.d. by that entire area (Greeley, 2067-2068).

It. 5.0424. Contentions of Delaware.

The position of Delaware differs from that of the other parties, in that the State makes no potable use

of the waters of the Delaware River (Del. S.M. 11). It, therefore, has not shown any necessity for developing new sources of water supply for potable purposes. It has shown, however, that Delaware has many uses of the water of the Delaware River, some of which are unique to it. In the northern portion of the State from the Pennsylvania line to Wilmington a great industrial use is made of the river. To the south of Wilmington and in the marsh lands that constitute 8% of the total land area of the State, muskrats and wild water fowl abound. In the lower river and bay a large oyster industry flourishes. Recreational facilities are to be found on almost all stages of the river and bay.

All of these uses depend in large measure upon the flow of the Delaware River. Thus, Delaware contends that any impounding and proposed diversion of water from certain New York tributaries of the Delaware River affecting these uses may vitally affect Delaware, its industries, resources and citizens.

Industrially, northern Delaware constitutes an extension of the Delaware Valley, U. S. A. A survey conducted by the Chamber of Commerce of Delaware of eleven industrial plants in the Wilmington area disclosed that 430,309,800 gallons of river water are used each day by Delaware's industry. As a specific example, the Delaware Power and Light Company, located on the Cherry Island marsh, on the Delaware River near Edgemore, Delaware, uses approximately 160,000 gallons of water per minute on a 24-hour basis for condensing purposes in two generating units. A third unit is being added, which, upon completion during the winter of 1954-1955, will increase the use of Delaware River water to 345 million gallons per day. Another illustration of the industrial use of the Delaware River is the titanium dioxide pigment plant at

Edgemore, Delaware, which is owned and operated by E. I. duPont de Nemours & Company. There, 21,600,000 gallons per day of river water are used for cooling purposes in the operation of the plant.

In all cases of industrial use in Delaware, the quality and quantity of water of the Delaware River is of great importance. With normal river salinity of 40 to 50 parts per million of sodium chloride, the replacement and maintenance costs of industrial equipment, casts a heavy financial burden upon industry. If salinity is increased by the proposed diversion, it will cast a heavier burden upon industry in the form of expensive water treatment equipment and processes utilizing alloy materials and protective coating to correct and withstand such water conditions in order to combat pitting and general corrosion of heat exchanges and cooling coils.

In the extensive tidal marshes of Delaware's coastline, constituting some 8% of the area of the State, a large muskrat industry thrives. In such areas, there are also to be found important wintering grounds for an average of 60,000 water fowl each year. Both provide revenue and recreation to the inhabitants of the State of Delaware. In both instances, the population of muskrats and water fowl is dependent upon the quality and quantity of food and cover grown on such marshes. This, in turn, is determined by the quality and quantity of the water which supplies the marshes, since higher quality foods are found in fresh waters, and, consequently, water fowl and muskrat numbers are almost in inverse proportion to the amount of the salinity of the tidal waters.

The most critical period for the plant life which constitutes the cover and food grown on the marshes occurs in the spring, when the salinity of the river

and upper bay is at its lowest point during the year. Thus, without any diversion, salinity would continue to be lowest in the river and bay during the spring. On the other hand, the proposed diversion during the spring of each year will result in a lesser downstream flow, which may affect vitally the growth of the plant life and cover in the marsh areas.

In the estuary of the lower Delaware River and Delaware Bay are to be found many resources which may be affected by a diversion of the flow of the Delaware River. In addition to the use of the Delaware River and Bay for transportation, aquifer recharge, waste disposal, production of game mammals and birds, and recreation, there is a large oyster and clam industry out of Port Mahon and Bowers Beach. Blue crabs are caught for commercial profit and for pleasure from Port Penn to Lewes. Party-boat and small-boat pleasure fishing is carried on from Port Penn, Fleming's Landing, Woodland Beach, Little Creek, Bowers Beach, Mispillion Inlet, Slaughter Beach, Broadkill Beach, and Lewes. The netting of food fish extends from New Castle to Lewes. While the precise figures on the annual value of its estuarine crops are not available, they are clearly a multi-million dollar phase of the economy of Delaware.

Thus, while Delaware does not contend that there is a present necessity for developing new sources of water supply, it argues that the Delaware River is its sole source of water supply and that no other source is available from which water to supply such needs can be obtained. It contends that whatever future development is to occur within the State depends directly upon the availability of its source of water supply and upon its further development and utilization.

Cl. 5.043. The Source.

It. 5.0431. Contentions of New York.

The City contends that the wafers of the Delaware River and its tributaries, including the flood waters, are of such quantity that, if conserved and properly regulated, there will be sufficient to meet all the needs, present and future, of the parties and their municipalities and citizens.

The City requests permission to divert an additional 360 m.g.d. making a total of 800 m.g.d. from the Delaware watershed. The proposed Cannonsville Reservoir on the West Branch of the Delaware River is the City's most suitable source for the following reasons:

First. The dependable yield of the City's water supply will be increased to 1820 m.g.d., which will mean that the City will obtain a supply which should prove adequate for the balance of the century (City Ex. 5, Fig. 6).

Second. The Cannonsville supply will be obtained by gravity, thus precluding expensive pumping operations with the attendant possibility of interruptions due to mechanical breakdown, power failure, and other causes (Huie, 15).

Third. The addition of this pure mountain water to the City's distribution system will postpone for an indeterminate period the necessity for expensive treatment operations (City Ex. 4, findings 30-32).

Fourth. The Cannonsville supply is an economic source easily integrated with the City's existing system by tunnel connection with Rondout reservoir and the Delaware Aqueduct (Huie, 15; City Exs. 4, 7-A):

The total drainage area of the river above tidewater at Trenton amounts to 6780 square miles (Special Master's Ex. X, *infra* p. 120). Of that total, there are 2380 square miles in New York, 3460 square miles in Pennsylvania, and 940 square miles in New Jersey. Measured in terms of watershed, the Cannonsville reservoir will develop a drainage area of 450 square miles. The Neversink reservoir (completed this year) has a drainage area of 93 square miles, and the East Branch reservoir (to be completed in 1956) has a drainage area of 372 square miles. The three reservoirs will develop approximately 39% of the drainage area of the Delaware River located in the State of New York (Kennison, 222-224; City Ex. 7; City Ex. 32-A).

The average long-term runoff of the watershed above Trenton amounts to about 11,810 cubic feet per second (c.f.s.) or 7640 m.g.d. Of that total runoff, about 4295 c.f.s. or 2780 m.g.d. is derived from the New York watershed; 5925 c.f.s. or 3830 m.g.d. from the Pennsylvania watershed; and 1590 c.f.s. or 1030 m.g.d. from the New Jersey watershed (Kennison, 222).

The total mean annual runoff for the three New York developments is 1689 c.f.s. or 1091 m.g.d. (City Ex. 32-A). Of this, 800 m.g.d. or about 29% of New York's total runoff in the Delaware watershed is to be used for the City's municipal water supply (Kennison, 223). Considered in terms of the average long-term runoff for the entire watershed above Trenton (7640 m.g.d.), New York proposes to use for municipal water supply about 10.4% of that runoff (Kennison, 224).

New York contends that it is seeking permission to develop, at its sole expense, approximately 39% of its watershed. The Neversink and East Branch de-

velopments provide 178 billion gallons of storage. The Cannonsville development will provide an additional storage of 91 billion gallons, bringing the total storage of the three developments to 269 billion gallons (Kennison, 224; City Ex. 32-A). Under its proposed plan of development, the City's three reservoirs will yield to the City's water supply the equivalent of 800 m.g.d. and, at all times in the future, devote a minimum of 85 billion gallons of storage, or 32% of the City's total Delaware storage, to the regulation of the lower river (Kennison, 261).

It. 5.0432. Contentions of New Jersey.

The State of New Jersey contends that with minor exceptions all available intra-state sources of water supply for Northern New Jersey have been fully developed and are now in use to capacity.

New Jersey contends that it has an established right of diversion without requirement of compensation releases, of upward of 200 m.g.d. from the Delaware River via the Delaware and Raritan Canal, which right accrued to the State by the purchase of such Canal. (N. J. Answer to Petition, p. 6; Critchlow, 1024 *et seq.*)

New Jersey contends that with the exceptions noted above, its only source of additional water supply for Northern New Jersey is the Delaware River and its tributaries in New Jersey. The State has under consideration available storage or diversion possibilities on the Musconetcong River, Flat Brook, Paulins Kill, and the Pequest River, all of which are tributaries of the Delaware lying within the New Jersey watershed. In addition, New Jersey has enacted a statute which will enable Pennsylvania to construct a reservoir on the main Delaware River near Wallpack Bend

(N. J. S. M. 21). In case such a reservoir is constructed, New Jersey may pay a proportion of the cost and obtain as much as a 30% interest in its yield (Critchlow, 1018-1035; Sherman, 1041; Special Master's Ex. X).

New Jersey contends that the only available source of water supply for its municipalities and industries within the Delaware River watershed is the Delaware River.

It. 5.0433. Contentions of Pennsylvania.

With regard to the uncontroverted fact that the Delaware River and its tributaries are the sole available future source of water supply for Philadelphia and southeastern Pennsylvania, the main Pennsylvania witness was Charles E. Ryder, who for more than 40 years has especially studied the use, conservation and development of the waters of the Delaware River basin, is familiar with the several past studies and reports thereon by engineers in the employ of the City of Philadelphia, and was for many years chief engineer of the Commonwealth's Water and Power Resources Board. He participated in the 1925 and 1927 Compact negotiations between the three states, and was one of the principal engineers for Pennsylvania in the 1930-31 proceedings (Ryder, 2098-2101).

As a result of his life-long studies, Ryder is convinced that the Delaware River and its tributaries are the sole and only economically justifiable source of water supply for Philadelphia and southeastern Pennsylvania in the not too distant future, when they must abandon their present downstream supply because of the ever increasing pollution and go upstream to the main Delaware River channel above Trenton or its tributaries or both. Every engineering study and

report since 1865 has recommended such an upland supply but no site has ever been chosen, because the move upstream has not yet been considered financially feasible.

Ryder considers that a Lehigh-Nescopeck reservoir development would be the best unfiltered upstream supply, and that a gravity supply from a Wallpack Bend reservoir or a pumped supply from Yardley, both of which are on the main channel above Trenton and should be filtered, would be superior to the present Torresdale supply (Ryder, 2101-2106).

He states that based on (1) a flow line elevation of 415 feet (to avoid appreciable increases in flood stages at Port Jervis), (2) a net storage capacity of 75.5 b.g. or 10.1 b.c.f. in the very dry season of 1930-31, (3) a minimum maintained flow at Montague of .1750 c.f.s., (4) a dam flow of 1120 c.f.s. (0.3 c.s.m.), (5) a Trenton flow of 1760 c.f.s., and (6) a New York diversion of 800 m.g.d., the Wallpack Bend gravity project with a closed conduit will yield 756 m.g.d. for water supply purposes, of which Pennsylvania will take at least 70% or 529 m.g.d. and New Jersey may take 30% or 227 m.g.d. under their negotiated agreement (Ryder, 2106-2115).

If the water impounded at Wallpack Bend is allowed to flow downstream and is taken at Yardley, then with the Wallpack Bend storage capacity increased from 75.5 b.g. or 10.1 b.c.f. to 95 b.g. or 12.7 b.c.f., because no pressure head is required to be maintained, but all other factors remaining the same, the yield will be 1082 m.g.d. (Pa. Ex. 216) which will be adequate to the year 1986 (Ryder, 2115-2117).

Ryder asserts that a Lehigh-Nescopeck-Yardley project (with a Lehigh River impounding reservoir and conduit near Bear Creek, a Nescopeck storage reservoir and a taking at Yardley) will produce a

supply of 1218 m.g.d. if the minimum Trenton flow is kept at 1760 c.f.s. (Pa. Ex. 217). This project will have a net storage capacity of 150.3 b.g. or 20.1 b.c.f. on the Nescopeck, a minimum Nescopeck release of 47 c.f.s. or 0.15 c.s.m. and a maintained Yardley flow of 3800 c.f.s. A supply of 1218 m.g.d. will suffice to the year 1992 (Ryder, 2117-2120).

Ryder finally states that a Wallpack Bend-Lehigh Nescopeck-Yardley project will produce a supply of 1696 m.g.d. that will be sufficient until the year 2025 (Pa. Ex. 218). This project will comprise a Nescopeck storage reservoir of 150.3 b.g. or 20.1 b.c.f., a Wallpack Bend storage reservoir of 95 b.g. or 12.7 b.c.f., and a maintained Yardley flow of 4540 c.f.s. It is in addition to a New York diversion of 800 m.g.d. and a New Jersey canal diversion of 100 m.g.d., both diversions being outside the watershed (Ryder, 2121-2124).

Abel Wolman was a member of the Engineering Panel on Water Supply of the Sub-Committee for Water Supply of the Mayor's Committee on Management Survey, that rendered in July, 1951 a report upon the future water sources of the City of New York. He considers that the Hudson River with filtration offers the best solution to the future water supply needs of New York City. He believes that a new supply will probably not be required before 1980 because the rate of increase in New York City's consumption of water is profoundly less than the estimate thereof by the New York City Board of Water Supply (Wolman, 2410-2422).

The principal conclusions and recommendations of the engineering panel (Pa. Ex. 229) were that (1) the City's 1950 population of 8,000,000 is estimated to increase to 9,000,000 in the year 1980, and to 9,250,000 in 2000; (2) the water requirements of New York City were 1200 m.g.d. in 1950, less 100 m.g.d.

that can be saved through continued conservation, and are estimated to reach 1775 m.g.d. by 2000; (3) the safe yield of the City's present upland sources will be 1455 m.g.d. upon the completion of the new source of supply in 1956, and an additional source of supply will be needed between 1965 and 1970; (4) a saving of 100 to 200 m.g.d. can be effected by the prompt detection and checking of waste of water in streets and unmetered consumption; (5) the Hudson River with filtration is the best solution and should be the next step for meeting the water needs of New York City; (6) there is ample time to undertake the detailed study of the most practical means of developing the Hudson River as an auxiliary supply and to proceed to the preliminary stage design; and (7) all surface water supplies should be filtered because filtration will introduce the important additional factor of safety, will prevent corrosion difficulties, and will provide sparkling clear water free from taste and odors (Wolman, 2416-2420).

Pennsylvania contends that New York's freedom of choice as between the Delaware and the Hudson must be limited by the future growth of population and industry in the lower Delaware Valley.

It. 5.0434. Contentions of Delaware.

Delaware's potable water supply is taken from the tributaries of the Delaware River and the ground water aquifers which are to be found within its boundaries. None of the potable water which is used in Delaware comes from the Delaware River itself (Del. S.M. 11). Thus, as has been pointed out in the preceding section, the position of Delaware in respect to the use of the river for potable water supply purposes differs from the interests of the other parties to these proceedings.

As will appear by reference to Special Master's Exhibit X (*infra* p. 120), there are two presently existing reservoirs which, together with the Brandywine River, a tributary of the Delaware, and wells, constitute the available sources of water supply in the State. The Edgar Hoopes reservoir has a drainage area of approximately 2 square miles and contains 2.2 billion gallons of water; the Delaware Water Co. reservoir, having a drainage area of 48 square miles, has a capacity of .008 billion gallons.

Cl. 5.044. The Effect of the Proposed Plan of New York.

It. 5.0441. Contentions of New York.

The City's proposal to obtain a new source of supply at Cannonsville does not cause damage to the lower riparian States. The City contends that a true perspective of the operation of its plan over a long period of time is desirable and is shown on City Ex. 56 (NS 432). This exhibit shows the long-term operation of a substantially similar plan of impounding and releasing and any difference in the long-term averages because of the Montague formula is very slight (Kennison, 270E). This exhibit shows that the highest observed flows occurred during the month of March and April and during those two months the highest rate of impounding occurs. The City contends that this happens at a time when the river can afford to give up to the reservoirs a substantial portion of its flow—and approximately 10% of the flow is so utilized. The chart also shows that on the long-term average the lowest flows occur during the months of August and September. During those months the river normally is not in a position to give up water to the reservoirs. Only a very small portion of

its flow can be utilized for storage, and that only during wet years or periods of flash flood conditions (Kennison, 270E).

The plan of development and the operation of the Montague formula will not have any substantial effect on the salinity of the lower bay of the Delaware River. From Trenton to the Capes the Delaware bay and estuary cover about 776 square miles, and from Liston Point to the Capes the bay has a length of 50 miles and a width, at its widest point, of about 27 miles. The United States Corps of Engineers has furnished considerable data respecting Delaware Bay (City Ex. 40, 23; Tabs. VI, VII). The computations respecting tide volumes have been summarized in the record (Terenzio, 3095) as follows:

Trenton to the Capes	Billion Cubic Feet	Trillion Gallons
High tide volume	516.4	3.86
Low tide volume	424.0	3.17
Tidal exchange volume	92.4	0.69

Each tidal excursion results in a 6 to 8 mile shift of salinity, upstream with the flood tide and downstream with the ebb tide. The extent of the displacement and the distribution and intensity of salinities vary from tide to tide (Terenzio, 3096).

Inasmuch as the natural discharge of fresh water from the river into the bay is extremely small in comparison with the bay's great volume, the effect of the diversions on the mean salinity is extremely small. The average flow of the river in 34 years of record at Trenton is 11,770 c.f.s. (City Exs. 40, 35). The diversion of 440 m.g.d. would reduce this mean flow to 11,089 c.f.s. and the diversion of 800 m.g.d. would reduce it to 10,530 c.f.s. The Woods Hole Oceanographic

Institution has submitted studies on the average distribution of salinity and the effects of the diversion on that average (City Ex. 40-A). According to the Woods Hole estimates, the changes in salinity parts per thousand (p.p.t.) are very small. Woods Hole estimates that the diversions will have the maximum effect between stations 300 and 350, and that an 800 m.g.d. diversion will increase the salinity in that location by 0.85 p.p.t. (City Ex. 40, Fig. 10).

The City's plan will cause no damage to the oyster industry (Terenzio, 3089-3114).

The City contends that variations in salinity are inherent in the natural state of the bay and estuary and that the great forces of nature will always be the chief influence upon salinity concentration (Terenzio, 3107).

The effect of impounding during periods of high flow is comparatively slight. The chief periods of impounding are at times when the salt front is at or below the vicinity of Wilmington. The City contends that a permitted upstream advance in that vicinity is not harmful because that area is normally saline during other seasons of the year (City Ex. 47; Terenzio, 255).

The City contends that the plan of development and the operation of the Montague formula will have little or no effect upon the oyster industry and the wild life of the bay. The maximum volume of releases under the Montague formula in a twenty-four hour period is 160 million cubic feet or 1195 million gallons and, in contrast, a single tidal exchange volume in the bay amounts to 690 billion gallons (Terenzio, 3095). Thus, the maximum volume of release under the Montague formula is less than two-tenths of one per cent of a single tidal exchange volume

and less than one-tenth of one per cent of the total daily tidal exchange volume.

So far as the marsh wild life of Delaware Bay is concerned, the total watershed of the Delaware River above the Capes is 12,871 square miles (Special Master's Ex. X, *infra,* p. 120). The New York plan involves catchments of spring flows in 915 square miles or 7.1% of the total watershed above the Capes. New York contends that the catchments of spring flows in such a small portion of the watershed would have no effect upon the wild life of the bay and marshes. New York contends that the Woods Hole studies support its position that catchment during periods of spring flow will have very little effect upon the salinity of the bay and consequently upon the wild life of the bay and marshes (City Ex. 40-A).

As a conservation measure, the 1931 decree contained the following formula requiring releases from the New York developments during periods of low flow. If the stage of the river fell below 0.50 cubic feet per second per square mile (c.s.m.) at either Port Jervis or Trenton, the decree provided that water must be released from the City's impounding reservoirs on the Neversink and East Branch in sufficient volume to restore the flow to 0.50 c.s.m. The formula, however, contained a ceiling on the amount required to be released of 0.66 c.s.m. of the watershed areas under development. That meant that the Neversink and East Branch developments, having an area of 465 square miles, were not required to make releases to the lower river in excess of 306.90 c.f.s. at any time.

The Montague formula is to be substituted for the decree formula and will become operative as soon as the Neversink and East Branch reservoirs are put into operation. Instead of using Trenton and Port

Jervis as control points, the Montague formula establishes a single control point on the main river downstream from the mouth of the Neversink, the lowest tributary under development. This control point is the existing gaging station at Montague, New Jersey, maintained by the United States Geological Survey (Huie, 236).

The Montague formula provides that prior to the construction of the Cannonsville reservoir the City shall maintain a minimum uniform basic rate of flow at Montague of 1525 c.f.s. and, after the completion of the Cannonsville project, a basic rate of 1750 c.f.s. In addition to the uniform basic rates, the City is also required to release in each year an excess quantity of water equal to 83% of the amount by which its estimated demand in that year is less than its estimated continuous safe yield from all sources, obtainable without pumping. Its estimated demand in any year cannot exceed the highest consumption in any preceding year by more than 7¼ billion gallons. The formula provides that this safe yield shall be taken as not less than 1355 m.g.d. before, and as not less than 1665 m.g.d. after, the proposed Cannonsville reservoir is put into operation. If, after Cannonsville and prior to 1993, the City increases its net safe yield such greater safe yield shall govern the determination of the excess releases.

The formula further provides that these excess releases shall be concentrated in the dry months of each year commencing June 15th and shall continue for as long a period as the additional quantity permits, for the purpose of maintaining the then applicable uniform basic rate plus an additional rate computed to consume the total excess quantity in a period aggregating 120 days whether or not continuous. This 120-

day period extends over the four months of normally low flows. Should the normal low flow conditions not exist, the excess quantity will be released over a longer period but not beyond the following March 15th.

A ceiling is placed on the maximum excess quantity to be released, expressed either as 70 billion gallons in any year or as a quantity no greater than necessary to maintain 2650 c.f.s. at Montague (Amended Petition, par. 21; Huie, 237, 239).

Prior to the completion of the Cannonsville project, a basic rate of flow of 1525 c.f.s. is to be maintained at Montague. During that period the amended petition requests an increase in the draft from the Neversink and East Branch reservoirs over the draft authorized by the 1931 decree. The safe yield without pumping of 1355 m.g.d., specified in the Montague formula, is predicated upon the authorization of the requested increase in the Neversink and East Branch diversions from 440 to 490 m.g.d. If such increase were not authorized, the corresponding safe yield would be only 1305 m.g.d. In other words, the increased diversion of the equivalent of 50 m.g.d. will not affect the ability of the storage capacity of the Neversink and East Branch reservoirs to maintain the basic rate of 1525 c.f.s. at Montague. Under present rates of City consumption, it will be possible for the City to make excess releases even prior to the completion of Cannonsville (Huie, 242-243).

The City contends that the Montague formula contains several valuable features. First, a basic rate of flow at Montague is maintained, which will have a permanent stabilizing effect upon the lower river. Second, the formula provides for the release of excess water, the volume of such releases being con-

tingent upon consumption by the City. Thus, the volume of excess releases will be gradually reduced as the consumption of water by the City increases. Third, the formula contains its own regulatory provisions for the measurement of the excess releases and the time of year when those releases shall be made (Huie, 241).

New York contends that the effect of the plan and the operation of the Montague formula will be extremely beneficial to the lower river. The runoff of the three reservoirs will be impounded principally during periods of high flow in the winter and early spring and during flash flood periods in the summer and fall (Kennison, 222-223). Releases to the lower river will be made principally during periods of low flow in the summer and fall months. The seasonal operation of impounding and releasing is graphically illustrated on City Ex. 56 (NS 434-435). That exhibit shows the extent in variation which would have occurred in the flow at Trenton in the dry year of 1930 due to impounding and releasing if the Montague formula had been in effect with all three reservoirs in operation. The greatest variation due to impounding would have occurred in the month of March, when the observed flow averaged 12,701 m.g.d., and it would have been diminished by 2524 m.g.d. The greatest variation in the low flow period would have occurred in the month of October, when the observed flow averaged 1137 m.g.d. With a City consumption of 1435 m.g.d. or less, the operation of the Montague formula would have added 1020 m.g.d. With a City consumption of 1665 m.g.d. or more, the operation of the Montague formula would have added 438 m.g.d. to the average flow. The City contends that the Montague formula accomplishes a most favorable distribu-

tion of the waters conserved for the lower river. City Ex. 56 shows that practically no water would have been impounded during the months of July, August, September and November, and none at all in October, of 1930. Such impounding as did take place in the low flow months occurred during periods of flash floods.

In order graphically to illustrate the effect of the New York plan of development and the operation of the Montague formula upon the *daily* flow of the river, the City prepared hydrographs for the years 1930 and 1931, the two driest years of record (City Exs. 43-46). These hydrographs show the effect of the operation of the plan and formula upon each day's flow based upon different rates of City consumption. City Ex. 43 is based upon a City consumption of 1435 m.g.d. or less; City Ex. 44, a consumption of 1500 m.g.d.; City Ex. 45, a consumption of 1600 m.g.d.; and City Ex. 46 a consumption of 1665 m.g.d. or greater. Under the condition described in City Ex. 46, there is, of course, no excess safe yield and, consequently, no excess releases are being made to the river but the basic minimum uniform rate of 1750 c.f.s. is maintained at Montague. In comparison, City Ex. 43 shows the most favorable condition in the lower river caused by high excess releases during a period of lowest City consumption. The intermediate periods of increasing higher consumption and lower excess releases are shown on City Exs. 44 and 45. The computations for the preparation of these hydrographs are described in the testimony (Pratt, 247-252) and the computations for the excess releases are contained in City Ex. 42. The aggregate excess volume of water to be released and the increased rates of flow to be maintained at Montague during various rates of City consumption

are given (Pratt, 253). For example, with a City consumption of 1435 m.g.d. and a basic rate of flow to be maintained at Montague of 1750 c.f.s., the excess volume to be released is 69.66 billion gallons and the increased rate to be maintained at Montague is 2648 c.f.s. With a City consumption of 1600 m.g.d., the excess volume to be released is 19.69 billion gallons and the increased rate to be maintained at Montague is 2004 c.f.s. The City's estimated future consumption curve will not reach 1600 m.g.d. until the year 1976 (City Ex. 5, Fig. 6); and until that year, at least, it can be expected that very substantial excess releases will be made to the lower river (Kennison, 261).

The City contends that a most important aspect of the plan and formula is its influence in severe periods of drought. The minimum or permanent volume of storage required for release, regardless of the consumption demand upon the City's sources of supply, is 85 billion gallons of storage (Kennison, 260). Actually, as soon as the Cannonsville reservoir is completed and until the consumption demand shows an increase of about 50% over present City consumption, the required use of storage for river regulation is very much greater. For example, should a drought extend over a period of two years, the aggregate amount of the City's release from storage might be as much as 225 billion gallons; i.e., 85 billion gallons, plus excess releases of twice the annual maximum of 70 billion gallons. Such volume of storage might be required for release during a long drought until New York's consumption shows an increase of about 30% over the present consumption of approximately 1100 m.g.d. After New York's consumption reaches 1435 m.g.d., the amount of storage devoted for release to

the river will decrease and eventually drop to the minimum figure of 85 billion gallons when consumption is increased about 50% over the present figure (Kennison, 260-261).

In periods of extreme drought, the effect of the Montague formula upon the daily flow of the river at Montague is substantial. The lowest recorded flow at Montague occurred in the month of September 1941 (City Ex. 41-A). On September 24th the flow at Montague was 498 c.f.s. or 322 m.g.d. The City prepared a tabulation showing the average additional flow that would have occurred as a result of releases from New York storage under the Montague formula at various stages of City consumption. On September 24th, if the consumption had been 1435 m.g.d. or less, the City would have *added* to the flow at Montague 2152 c.f.s. or 1391 m.g.d. If the City's consumption had reached its maximum of 1665 m.g.d. or more, the City would have *added* 1252 c.f.s. or 809 m.g.d. In the former case, the flow at Montague would have been increased by about 430% and in the latter case by about 250%.

A most striking example of the effect of the Montague formula during an extended period of critically low flow is shown by the hydrographs of the flow at Trenton for the month of October 1930. During that month the average daily flow was only 1760 c.f.s. as compared with the long-term average of 6452 c.f.s. (City Ex. 56, NS 432). The average daily flow for the month of October 1930 of 1760 c.f.s. would have been increased by 1577 c.f.s. to an average daily flow of 3337 c.f.s. (City Ex. 43, consumption 1435 m.g.d.). With a consumption rate of 1665 m.g.d., the average daily flow would have been increased by 677 c.f.s. to 2347 c.f.s. (City Ex. 42, p. 178).

The City contends further that, while the hydrographs show how the releases are successful in timing the benefits to meet the needs of the river, the manner in which the Montague formula matches the magnitude of the benefit with the magnitude of the need is shown graphically on City Ex. 49. This exhibit shows that there were 78 days during the year 1930 when the natural flow at Trenton was less than 0.32 c.s.m. (2176 c.f.s.). If the 1931 decree formula had been in operation during that period, these 78 days would have been reduced to 36 days. If the City's developments had been operating under the provisions of the Montague formula, even with maximum consumption of 1665 m.g.d., these 78 days would have been reduced to 9 days. Thus, the City claims that the operation of the Montague formula, even at the highest rate of City consumption, will produce a very important seasonal benefit to the river during a critically dry summer (Kennison, 230-231, 263-264).

The City contends that the effect of the Montague formula will tend to reduce the range of salinity variation in the lower bay (City Ex. 40, 5). However, the City takes the position that the influence of flow-salinity relationships is insignificant in contrast with the great variations in salinity produced by natural conditions. New York contends that this conclusion is supported by studies of the Coast and Geodetic Survey entitled "Currents for Delaware Bay and River" which demonstrate the variable character of the current pattern throughout the tidal cycle over the bay and estuary (City Ex. 55; Terenzio, 3097, 3098).

The so-called salt front is defined in the City's studies as that area of the river which on its upstream side has a salinity of 30 parts per million (p.p.m.) of chlor-

ine and on its downstream side a salinity of 70 p.p.m. The average of 50 p.p.m. constitutes a chloride concentration of tolerable freshness and a bare indication of sea salt invasion, and the location of such consistent tolerable freshness is referred to as the position of the salt front (Terenzio, 56). The extent of this front varies from as much as 8 miles at Philadelphia to approximately one-quarter of a mile at Wilmington (Terenzio, 84). This variation is caused by the widening of the river and the spreading out of the mixing area of fresh and brackish water at Wilmington and the enlarging scope of other controlling influences such as winds and tides.

During the last twenty years there has been a northward shift of the salt front under similar flow conditions. The invasion of the salt front is now between 6 to 10 miles upstream from its location twenty years earlier. The causes of this advance upstream have not been definitely determined, but it is believed that channel enlargement aggravates salt intrusion (Terenzio, 61, 3096).

The position of the salt front is responsive to fresh water flows and to variations in those flows. During the heavy flow of the spring, the front is normally restricted to points at or south of Wilmington, and the balance of the river above Wilmington is fresh water. As opposed to that condition, periods of extended low flow will result in the salt front moving upstream to the general vicinity of Philadelphia (Terenzio, 188).

The City contends that the net effect of impounding in periods of high flow and releasing in periods of low flow under its plan of development will be to reduce the range of the salinity profile and the extremes of salinity concentration (Terenzio, 191). The degree

to which the upstream invasion of the salt front will be restrained by releases is related to the quantity of the release. The City has developed diagrams showing graphically the probable effect of the Montague formula upon the upstream advance of the salt front (City Ex. 47). The diagram NS 398 shows that under natural flow conditions sea water invasion will extend practically to Torresdale (Philadelphia's water supply intake) at times of minimum flow. The effect of the Montague formula would be to restrain the northern advance of the salt front by about five miles, the peak of the restraint occurring during the driest summer and fall months.

The City contends that its exhibits show that the plan of development and the operation of the Montague formula will tend to reduce salinity and restrain the advancing salt front at times when such restraint is most needed. The City contends that this benefit will accrue, regardless of how the location of the front is affected by other natural or artificial forces and conditions (Terenzio, 191; City Ex. 48).

So far as the oyster industry is concerned, New York contends that its plan will tend to reduce the great natural variations in salinity by lowering the high and raising the low salinity values (City Ex. 40, 5). On that account oyster cultivation will be aided in the same way as a reduction of drought on the one hand and a reduction of excessive rainfall on the other are beneficial to land farming. To the extent that the natural variations in salinity are regulated, the seed growth of oysters and the control of pests should be favorably affected (Glancy, 3056, 3057).

In respect to the future effect of the New York plan upon the lower basin, New York contends that its developments are located on the farthest upstream tributaries of the Delaware River. The beneficial releases for river regulation are, therefore, added at the headwaters, and this fact increases the opportunity for others to make uses of those releases. While at the present time New Jersey alone seeks to obtain an additional water supply of 100 m.g.d. from the Delaware, the Delaware River must become a principal source of supply for the entire lower Delaware valley in the future.

After the Cannonsville reservoir is completed, the City will have a total storage of 269 billion gallons, and under the Montague formula a storage capacity of 32% or 85 billion gallons must be provided for beneficial river regulation. In addition to that storage, the City is required under the formula to make excess releases in a volume dependent upon the City's consumption. Thus, the formula will make available for water supply purposes in the lower basin a substantial volume of water. For example, the lowest observed flow at Montague which occurred on September 24, 1941, was 498 c.f.s. or 322 m.g.d. Under the formula, if New York had reached its maximum consumption and had, therefore, discontinued making excess releases, the *additional* flow at Montague resulting from the operation of the formula would have been 1252 c.f.s. or 809 m.g.d. This additional flow represents an increase of 250% in the observed minimum flow. This increase represents the permanent effect of the Montague formula after Cannonsville during a period of critically low flow in the river. New York contends

that such permanent effect will always be of great value to the lower riparian States and the anticipated development of the lower Delaware basin. New York has always assumed that its releases under the Montague formula would be utilized for the benefit of the lower riparian States, including their water supply purposes. With a maximum use of its releases, the lower States will derive very important and practical benefits (Kennison, 3130).

New York contends that, if the lower States make a maximum use of its releases, its plan of development does not interfere in any way with possible developments by others, and actually postpones the necessity for expenditures for such developments. For example, it will postpone the necessity for the construction of a reservoir at Wallpack Bend and the Lehigh-Nescopek reservoir by 6 to 9 years (Kennison, 3130-3132).

New York, however, contends that the most important result is not the postponement of financial outlay but rather the assurance that the lower basin may, with the construction of relatively small storage, obtain a water supply which should prove adequate for at least seventy-five years.

With the passage of the New Jersey statute and the enactment of appropriate legislation by Pennsylvania, it will be possible for Pennsylvania to construct a reservoir at Wallpack Bend and a diversion dam at Yardley. Such a reservoir, coupled with the Yardley intake, would have a net storage capacity of 95.0 billion gallons, or 12.7 billion cubic feet (Ryder, 2215). After deducting the New Jersey diversion of 100 m.g.d., if the flow below the Yardley intake is maintained at 1760 c.f.s., there would be available for

water supply purposes 1082 m.g.d. New York contends that this yield of 1082 m.g.d. is derived from a storage capacity at Wallpack Bend only slightly greater than the storage at Cannonsville which yields 310 m.g.d. to New York. If the Wallpack Bend and Yardley project is coupled with a Lehigh-Nescopeck reservoir, there will be available for water supply purposes 1696 m.g.d., if a flow of 1760 c.f.s. is maintained below the Yardley intake, and this yield is in addition to the New Jersey diversion of 100 m.g.d. without compensating releases. This supply, it is estimated, will meet the future needs of Pennsylvania and Southern New Jersey up to the year 2025 (Ryder, 2122-2123, 5028).

New York contends that the most practical benefit of its plan of development and the operation of the Montague release formula will be a substantial reduction in outlay by the riparian States for the construction of required storage for their future water supply (Kennison, 261-263, 266-267; City Ex. 49, 50).

It. 5.0442. Contentions of New Jersey.

The beneficial results which will accrue to the State of New Jersey by the accomplishment of the proposed New York plan for the development of an additional water supply from the tributaries of the Delaware in New York State include the following (N. J. Ex. 1, 21-24):

> The minimum flows of the river will be effectively increased both as compared with natural flow, with the 1931 Supreme Court Decree and with previous proposals made by the City of New York.
>
> The provision for supplementary release makes the most advantageous use of water not needed by

New York City. Such release will be in addition to the minimum regulation at Montague and will in general be made during the summer months when additional water is of most value to the river.

The beneficial effects of improved river regulation and of supplementary releases on sanitation, fish life, recreation and industrial water supply are materially greater than under the 1931 Decree or under any other possible detrimental effect of the diversion of high water flows by the City of New York.

These real and lasting benefits will accrue entirely through money spent by the City of New York. Similar benefits, if financed by the State of New Jersey, would cost the State many millions of dollars.

The agreement eliminates the possibility of either New York City or New York State offering objections to diversion of water from the Delaware below Montague by the State of New Jersey.

With respect specifically to the effect of the plan on the quality of river water below the point of diversion, New Jersey concludes as follows (Powell, 1095-1097): The river water above Trenton will not be depreciated for industrial use to any significant degree at any time; and will be improved by the proposed compensation water made available at Montague during practically all low flow periods.

Supplementary releases, as planned under the terms of the agreement, and any other water of a quality similar to the released water which may be made available in the future, should still further improve the quality of the river water in this section of the river. This is due to the reduction of hardness

of the water which occurs because of the augmented dilution water.

The river water from Philadelphia southward is depreciated during reduced flow due to intrusion of salt. Under such conditions, total dissolved solids, hardness and chlorides in the water increase, thereby lessening the suitability of the water for industrial requirements. The proposed releases will improve this condition by lowering chlorides and other dissolved solids in this section of the river.

The scheduled releases at Montague and of supplementary water will tend to retard the movement of the salt water northward. These releases, however, will not be sufficient to provide fresh water conditions in the lower stretches of the river.

From an industrial viewpoint, the changes in quality of river water, due to the proposed diversions, will be too slight to materially affect treatment costs. Such changes as will occur will tend to lower these costs during low flows of the river.

With respect to the oyster industry in the lower Bay, Dr. Thurlow C. Nelson (Nelson, 1268) concludes that injury, not benefit to the oyster industry of Delaware Bay must result from operation of the New York Plan of storage, diversion and release.

Also Dr. Harold H. Haskin (Haskin, 1308-1309) testifies in summary as follows:

Storage of water during periods of high river flow under the New York plan would be expected to reduce oyster mortalities on the upper Natural Seed Beds somewhat. It is not expected that this reduction would be great.

Increase of salinities by withholding and diversion as planned, would favor the oyster drill. It is

calculated that the drills would move up-bay at least 0.8 miles and this would seriously endanger the Shell Rock Natural Seed Bed.

The increased salinities would also permit activity of the drill for a greater percentage of the time in the Bennies Bed area and thus lead to greater destruction here.

Releases of fresh water under the New York plan would have no effect whatever on the oyster drill.

A variety of other oyster predators and competitors now held in check by the same salinity barrier as the oyster drill, would move up-bay with it.

The claim of "benefits for biological populations" under the New York plan, is misleading. Because the changes in salinity regime would favor its principal enemy, the oyster industry would suffer immeasurably.

It. 5.0443. Contentions of Pennsylvania.

The principal Pennsylvania witness upon the effect of the New York diversion upon sanitation, salinity and industrial use of the Delaware River, insofar as the rights and interests of Philadelphia and southeastern Pennsylvania are concerned, was Theodore R. Haseltine, who opened his testimony by corroborating the opinions of Greeley, Ryder and Corddry that there would be no present damage from the New York diversion under the Montague formula but serious future harm, the time of which would depend upon the rate of population growth and industrial development and the utilization of the New York releases for water supply, to which New Jersey is presently opposed (Haseltine, 2186-2195).

Haseltine next enumerated his general conclusions that (1) Pennsylvania and New Jersey are vitally interested in preserving the quality of water of the Delaware River, from which river Philadelphia, Bris-

tol, Morrisville and Easton now obtain a considerable, if not their entire, public supply of which water Pennsylvania industries alone use 3200 m.g.d. directly from the river; (2) moderate stream flow augmentation under the Montague formula is of no over-all benefit and is less efficient and more costly than the treatment of sewage and industrial waste; (3) diversion and river regulation tend to offset each other at present; (4) any out-of-basin diversion will increase salinity penetration in the tidal estuary, the frequency, intensity and duration of which invasion has greatly increased in the past two decades without any corresponding reduction in river flow; (5) the New York diversion will have little practical effect upon the industrial use of Delaware River water because the slightly beneficial effect of the New York releases upon hardness and dissolved minerals will be offset by the increase in corrosiveness and aggressiveness of that water which will result from the New York taking and may prove serious; and (6) if New Jersey were to prevail in its opposition to the utilization of the New York releases for water supply this would constitute a serious waste of natural resources, increase the cost and decrease the yield of any upland water supply and would accomplish no useful purpose (Haseltine, 2193-2209).

Haseltine stated that the value of and the benefits from the moderate stream flow augmentation under the Montague formula had been overrated by the New York witnesses. Such augmentation will be slightly beneficial in that it will provide additional water for the dilution of sewage. However, unless and until augmentation provides a Trenton flow of 10,000 c.f.s., it will not become effective to offset the damage resulting from the decrease in time for reaeration (Haseltine, 2305-2310, 2395-2400).

The more deleterious effects of moderate stream flow augmentation are (1) the decrease in reaeration, the principal source of replenishing the tidal basin's supply of oxygen, and (2) the increase in bacteria, both of which will result from the speeding up of the time of transit in river flow through moderate augmentation and will be deleterious to the sanitary quality of Delaware River water. As a consequence, the treatment of sewage, which is cheaper and more efficient, is preferable to augmentation (Haseltine, 2305-2310; 2395-2400).

Haseltine introduced detailed data pertaining to sanitary conditions in the four zones of the Delaware River, namely, Zone 1 above Trenton, Zone 2 between Trenton and Philadelphia's Torresdale intake, Zone 3 between Torresdale and the Delaware State Line at Marcus Hook, and Zone 4 below the Delaware-Pennsylvania line (Haseltine, 2230-2361; 2307-2310).

Haseltine has reviewed the earlier investigations of salinity conditions in the tidal estuary and bay of the Delaware River, including the studies of the United States Engineers; has contacted every industrial user of river water and examined their records and data on salinity; and has consulted with the New Jersey Engineers and the United States Coast and Geodetic Survey regarding their studies and reports upon bay and ocean salinities. The conclusions of the various investigators of salinity are in agreement that (1) the obvious and most important factors in salinity invasions of the Marcus Hook-Chester areas are tidal phenomena and fresh water inflow; (2) high chlorinities are generally encountered during and immediately after periods of low run-off; and (3) the attempt to correlate the position of the salt front with surface run-off has been unsuccessful because of the complexity of the salinity problem which is affected by

many variables such as ocean level, ocean salinity, tidal phenomena, river discharge, ground water inflow, evaporation, rainfall, winds, ship movements, temperature, channel changes, sediment deposition, construction of docks, piers and bridges, etc. (Haseltine, 2311-2329).

Haseltine and his associates concluded that (1) no reliable estimate of salinity movement in the Delaware Bay and Estuary can be based on river flow alone, as neither river flows nor tidal phenomena remain constant enough to permit the establishment of an equilibrium condition, while numerous other factors influencing salinity movements are continuously changing at slower rates; (2) a minimum mean monthly "combined river discharge" of 8300 c.f.s. is required under 1951 conditions to prevent salinity penetrating Marcus Hook in significant amounts; and (3) their studies of 1951 salinity conditions indicated that a lesser flow than 8300 c.f.s might be tolerated for a few weeks if appreciably higher flows had prevailed for sometime immediately previous, but if the chlorides were already high at Marcus Hook then either considerably higher flows or a prolonged period of time at a combined river flow of 8300 c.f.s. would be required to reduce them (Haseltine, 2329-2330).

Haseltine pointed out that there were at least four variable factors affecting salinity movement in the estuary and bay that had been omitted or else were inadequately considered by the New York witness Terenzio. The first factor is the very pronounced over-all rise in ocean and river level which has been common to the entire Atlantic seaboard, has materially increased the ease with which ocean water can enter Delaware Bay, and has had a pronounced effect on the tidal range. This rise which was mentioned by Terenzio but not considered for its possible effect on

salinity movement may be due to the general warming of the world's climate, particularly in the northern hemisphere, that has resulted in the polar ice cap melting more rapidly (Haseltine, 2330-2334).

The second factor is the sharp increase in tidal ranges since 1930 although the fresh water run-off of the Delaware River has remained practically the same. This increase is not attributable solely to the rise in the ocean level; but may be also due to the periodic lunar changes in the tidal ranges during every nineteen year cycle, which changes tend to decrease the tidal range during the first half of the cycle and to produce abnormally large increases in tidal range during the second half, thus accounting for the "stair step" pattern of the tidal range curve. If such cyclical changes do bring about large increases in tidal range, then another marked increase thereof may be expected in about 1959-60 with perhaps another marked increase in the severity of the salinity invasions. Terenzio did not in Haseltine's opinion give sufficient consideration to this change in tidal phenomena (Haseltine, 2334-2338).

The third factor is the falling ground level east of the southeast "fall-line", which drop gives grave concern to the New Jersey engineers, has resulted in a deterioration of the quality of the water obtained from the many wells in New Jersey, and has even permitted some salt water intrusion. This decrease in the ground water level may mean that the natural inflow of ground water into the lower river and bay has been reversed, and that Delaware River water is now entering the New Jersey and Delaware aquiferent sands east of the southeast fall-line, thereby causing a reduction in the actual amount of surface run-off that is available to combat the invasion

of sea water in the estuary and bay (Haseltine, 2338-2345).

The fourth factor is the Schuylkill River inflow, which also affects the salinity front. Terenzio did not adequately consider this substantial but variable inflow (Haseltine, 2348-2349).

No one is able to forecast how long and to what extent the foregoing trends of higher ocean and river levels, greater tidal movement and falling ground water level will continue, and therefore future salinity conditions are not forecastable. Haseltine is of the opinion that any out-of-basin diversion will increase salinity, and that no river regulation can or will prevent the increase. Under present conditions, a regulated "combined river" flow of 8300 c.f.s. is necessary to keep the penetration of sea water below the Delaware-Pennsylvania line; and if the ocean level should continue to rise and the ground water table should continue to fall, then it will become even more impractical to provide sufficient river regulation at Trenton to prevent penetration below that line. Although no present serious harm to salinity conditions will result from the proposed New York diversion, yet any out of basin diversion will tend to increase the frequency, duration and intensity of salinity invasion. The New York releases will not be as beneficial as the City claims, and river regulation under the Montague formula will not be sufficient to prevent the frequent penetration of sea water (Haseltine, 2345-2370).

With regard to the chemical quality of Delaware River water for industrial uses, Haseltine stated that total hardness was caused by (1) alkalinity or carbonate hardness which is due to the presence of calcium and magnesium carbonates and bicarbonates, and (2) non-carbonate hardness which is due to sulfates,

chlorides and nitrates of calcium and magnesium. The hardness of Delaware River water is caused by (a) calcium bicarbonates and (b) calcium and magnesium sulfates. Water of very low alkalinity is aggressive or corrosive and requires corrective treament by adding a corrosion inhibitor, whereas carbonate and sulfate hardness in water is objectionable in that it requires more soap for domestic uses, laundering and electro-plating, and causes hard scale in cooling systems, boiler feed water, etc. Cooling is the major industrial use of Delaware River water (Haseltine, 2379-2389).

The over-all effect of the New York and New Jersey diversions on the chemical character of Delaware River water will be slight, because less than 2% of that water is softened for industrial use. The New York release of water during low flows will tend to reduce the hardness of Delaware River water when it normally is at the greatest; but will tend to increase corrosiveness or aggressiveness, which increase in aggressiveness will overshadow the slight decrease in hardness. The slight increase or decrease in hardness and aggressiveness depends largely upon the point of taking (Haseltine, 2389-2392).

Greeley prepared and submitted 16 diagrams to show the relationship between water needs and net available water quantities and to fix the amount of Delaware River water that for various New York and Pennsylvania reservoir combinations can be made available at Trenton for water supply at the four average monthly flows of 1750, 2000, 2400 and 3400 c.f.s. (Pa. Exs. 211-214). The reservoir combinations used were the three New York reservoirs of Neversink, Pepacton (East Branch) and Cannonsville, and the two Pennsylvania reservoirs of Wallpack Bend and

Lehigh-Nescopeck. These diagrams were prepared from mass flow curves; and reveal that Pennsylvania's water needs will catch up with and exceed the net available quantity of Delaware River water in the not too distant future, i.e., the year 1978. Dependent upon various assumed conditions, the critical years will be from 1978 to 2036, if a Trenton flow of 1795 c.f.s. is to be maintained.

Under Case I the available quantity of Delaware River water up to the year 1966 will be about 685 m.g.d., of which Pennsylvania's share is 535 m.g.d., and lower New Jersey's 150 m.g.d. Consequently, Greeley insists that the proposed New York and New Jersey diversions of 800 and 100 m.g.d., respectively, shall not be perpetual and that corrective measures must be taken when the New York and New Jersey diversions interfere with or harm the future water needs of Pennsylvania and New Jersey (Greeley, 2069-2086, 2087-2094).

Greeley stated that although harm would not at this time be caused to Pennsylvania by the proposed New York diversions and releases, his studies clearly showed that the time would come when the water needs of the inhabitants of Pennsylvania would be harmed and restricted; and that Pennsylvania could not accept the present New York plan, unless it was clearly understood that (1) the proposed diversion would not be considered as permanent and perpetual and (2) the present plan would be fully adjusted, when necessary, so as not to interfere with the needs of the lower basin. He added that in view of the large expenditure which New York proposed to make for the low Cannonsville Dam and the related conduits and other works, it was only fair that they should be fully apprised at this time of the likelihood that the

total diversion of 800 m.g.d. from the basin by New York would in the future cause damage to Pennsylvania (Greeley, 2061-2062).

Greeley stated that probably eight to ten years before the critical year of 1978, when the net available quantity of river water would be insufficient to supply the water needs of the Pennsylvania and lower New Jersey inhabitants of the basin, it would be necessary to reconsider the river problem, including the proposed total diversions by New York and New Jersey in order to allow time for any reconstructions or new constructions or operating adjustments to be made; and that a good time to do this would be shortly after the completion of the Cannonsville dam (Greeley, 2085, 2093). He asserted that it was important to note that the changes proposed under the Montague formula, which included a complete diversion of a greater quantity of water from the basin, would harm the Commonwealth in the future if they were compared to the conditions which would result from the use of the full storage capacity of the two New York reservoirs built following the 1931 decree. Because of the increased diversion and the operation of the reservoirs under the Montague formula, the additional storage of 20.1 b.c.f. represented by the volume of the Lehigh-Nescopeck Reservoir would be required about seven years sooner (Greeley, 2094).

He expressed the opinion that the presently proposed plans, works and operations for the development and use of the Delaware River must not be perpetual in any degree; that because the future water needs of the Commonwealth could not be predicted with too great assurance, it was essential that the Commonwealth should have complete freedom regarding its future water needs and that no present ar-

rangements should be binding; and that no proposed total diversion by New York could be accepted as a permanent indication or commitment of what would be fair and equitable between the State of New York and the Commonwealth of Pennsylvania (Greeley, 2094).

His concluding statement was that when the proposed total diversions by New York and New Jersey injured or interfered with the water needs of Pennsylvania and New Jersey, New York must take corrective measures which are illustrated by but not necessarily limited to the following: (a) build more reservoirs, (b) provide for the storage of higher flood waters, (c) reduce their diversion, or (d) go elsewhere for water (Greeley, 2094).

Greeley's warning to New York and New Jersey is the basis for Pennsylvania's insistence that any modified decree shall include the condition stated in paragraph 30(b) of its answer to the amended petition of the City of New York, which condition specifies:

> "(b) Notwithstanding any expenditure made by New York to construct the Cannonsville reservoir and appurtenances, intervenor's failure now to object shall never estop intervenor from requesting this Court further to modify the decree in such a way as to prevent damage to intervenor including if necessary the complete discontinuance of the additional diversion for which New York City is now requesting authority."

Ryder testified that in his judgment it was most important to recognize the principle that the proposed diversions by New York City should not be permitted to jeopardize the claimed superior right of Pennsylvania and New Jersey to obtain the quan-

tities of water needed to meet the future requirements of municipalities within the Delaware River basin. The growth and development of the lower Delaware Valley should not be retarded by reason of the diversion of large quantities of water outside the basin, so that if and when the time arrives when it appears that the withdrawal of 800 m.g.d. as proposed might result in such a contingency, New York City should be compelled either (a) to increase the height of the Cannonsville dam or (b) build additional reservoirs in New York State for the sole purpose of releasing more water down the channel of the river, or (c) go to the Hudson River for an additional supply, thus making possible greater releases with reduced diversions from the Delaware reservoirs (Ryder, 2131-32).

Ryder further stated that as it was impossible to predict the future with any degree of certainty, this whole matter of the ultimate use and development of the Delaware River as between the contiguous States should in his judgment be kept as flexible as possible, to the end that each State may receive fair and equitable apportionments of water as future needs may develop. This same principle should also govern the matter of releases, which should be based upon such practical considerations and relative benefits as changing conditions may indicate to be desirable (Ryder, 2132).

Ryder corroborated and concurred in Greeley's statement that (1) the New York releases will help for a limited time, if they are used for water supply purposes as advocated by Pennsylvania, but will require corrective measures in the not too distant future, and (2) Greeley's estimates of population and water need are very conservative.

He also agrees with the studies by Corddry of the relationship of storage to yield at Wallpack Bend. It should be noted that although Greeley used mass flow diagrams and a 10% factor of adjustment, whereas Ryder based his computation on the 1930-31-32 river flows as modified under the Montague releases; their results and conclusions are in very close agreement (Ryder, 2132-2134).

Ryder insisted that New York City should be required to maintain a flow of at least 1750 c.f.s. at Montague every day of the year and criticized the proposed harmful New York City plan of operation because it would maintain that flow only "as nearly as practicable."

William H. Corddry testified that the claim made by New York City that its proposed reservoirs would capture only flood waters was inaccurate; and that there was a vast difference between the storing and diverting of flood flows and base flows. To demonstrate this, he prepared a graph illustrating the volume of storage required in relation to stream flow for the average daily hydrograph of flow of the Delaware River at Montague (Pa. Ex. 219), which graph shows that (1) for a given diversion utilizing high flows (8300 c.f.s.), the required storage is far greater than that needed for a taking at low (1750 c.f.s.) or intermediate (4000 c.f.s.) stages, (2) when low or intermediate flows are utilized, the highest flows are not utilized, and (3) when intermediate flows are utilized, average or normal flows are materially reduced for considerable periods (i.e., 110 days).

Corddry prepared a second graph (Pa. Ex. 220) to show (1) that a second or downstream taker of 800 m.g.d. must build six times more storage and at a greater cost than a first or upstream taker of that

quantity; and (2) that in order to prevent serious damage to the second taker, it is necessary that the first taker should build sufficient storage to permit a residual flow exceeding the minimum maintained flow of 1750 c.f.s., and that the second taker should be allowed to divert the excess of the residual flow above the minimum flow to be maintained (Corddry, 2138-2150).

In order to show the adverse effect of the New York project upon a subsequent Wallpack Bend development, Corddry prepared Pa. Exs. 221-224 to prove that the required storage progressively increases as the desired yield for water supply is raised; and that, therefore, New York should build larger or more reservoirs that will permit Pennsylvania to get any quantity of water it needs at or near the base flow of 1750 c.f.s. These Exhibits also prove that Philadelphia and southeastern Pennsylvania must be allowed to use the New York releases for water supply, whenever they abandon the lower basin for an upstream supply (Corddry, 2152-2172).

These graphs establish that the reasonableness of the 29% of the run-off of the New York drainage area, which will be impounded and diverted for water supply purposes, depends upon whether the diverted 29% is taken from the top or the base of the hydrograph and upon how much residual flow is left for utilization by others farther downstream. The crux of this problem is not the quantity of water taken percentagewise, but at what flows it is taken.

Corddry enumerated what he believed to be several untenable assumptions upon which New York City bases its claim of right to take increasing quantities of Delaware River water to meet its future needs (Pa. Exs. 225-226). Two of these assumptions are that

(1) the future growth and consumption of New York City is inevitable and hence it may pre-empt Delaware River water, which is cheaper and of better quality, regardless of the existence of an adequate local supply such as the Hudson River; and (2) the proposed New York diversion will take a low percentage of river flow, and will reduce floods because the taking will be at high flows (Corddry, 2172-2183).

Finally Pennsylvania vigorously contends that, if the predictions of its witnesses come true regarding the growth of population and industry in Delaware Valley U. S. A. and the future needs of that area for water supply which can come only from the Delaware and its tributaries, and, if the predictions of the witnesses for New Jersey come true that in the not too distant future northern New Jersey will have a demand for water supply which cannot be satisfied from intrastate sources but only from the Delaware and its tributaries, the order in which the future equities should be determined is as follows:

First. Delaware Valley U. S. A. which is within the Delaware River watershed;

Second. Northern New Jersey, which, although outside of the watershed, is alleged to have no other source of future water supply to satisfy its needs; and

Last. New York City, which, while it prefers the pure mountain water obtained from the upper reaches of the Delaware, has an alternative supply unlimited as to quantity which, by filtration, can be made just as safe as the water which New York is now taking from the Delaware. In this connection, Pennsylvania points out that the raw water now processed through Philadelphia's filters is far inferior in quality to the water which could be drawn by New York City from

the Hudson River at or near the point recommended by the Mayor's Subcommittee of Engineers, of which Wolman was a member.

It. 5.0444 Contentions of Delaware.

Delaware has shown that, as a sovereign State bordering on the Delaware River and Bay, it has long been interested in the many problems facing the development of the Delaware River Basin (Gassaway, 6001), and that many industrial and commercial enterprises lying in this area depend completely upon an adequate supply of water for present and future purposes if the industrial expansion of the Basin is to continue. It was shown that for industrial purposes salinities of a density of 150 parts per million chlorides will produce damage to industrial properties (Gassaway, 6003); that there might be a direct relationship between the proposed diversions and the contamination problem that presently exists in the river (Gassaway, 6004); that there are a number of instances in the Wilmington area in which industrial use of the Delaware River water has been discontinued because of the combination of increasing salinity and contamination by sewage discharge and that a further diversion might have the effect of further contaminating the waters and rendering them unfit for industrial use (Gassaway, 6004). It was also shown that a number of industries in the Wilmington area, which rely upon wells for their source of water for industrial processing, have been forced to abandon the use of such wells because of salt intrusion, and that studies have indicated that there is a direct relationship between the salinity front of the river and the salt contamination of the wells in the New Castle area (Gassaway, 6005). Thus, if the proposed diver-

sions of either New York or New Jersey, or both, result in a further extension of the salt front of the Delaware River and in a greater saline density in the Delaware area, irreparable harm to Delaware and its industrial interests may result.

Delaware wildlife depends upon the quality and quantity of the food cover grown on the marshes which, in turn, depends on the quality and quantity of the water available in the early spring months. It was argued that the increased diversion by New York and New Jersey, or both, will have a direct effect upon Delaware wildlife. Delaware's position was stated by Norman G. Wilder, the Director of Conservation of the Delaware Board of Game and Fish Commissioners, as follows: The marsh wildlife will prosper under the present plan of no diversion during the critical spring months and will be adversely affected by the proposed diversion. The extent of the injury and harm cannot be estimated at this time. The Delaware Board of Game and Fish Commissioners cannot predict an adverse effect upon the marsh wildlife in the State of Delaware by the proposed diversion of the headwaters of the Delaware River (Wilder, 6018).

Delaware also demonstrated that the diversion of water from the Delaware River with releases as proposed by the States of New York and New Jersey may seriously injure the estuarine resources of the State of Delaware. Dr. Cronin, the Marine Biologist in the State, summarized the effects as follows: Diversion of water from the Delaware River with releases, as proposed by the states of New York and New Jersey, may seriously injure the estuarine resources of the State of Delaware. These resources will be affected, although the precise direction and magnitude cannot yet be stated, because the biological suc-

cess of each species is intimately associated with the flow of Delaware River water through the lower River and the Bay. There is a lack of detailed micrometric estimate of the effects, but there will not be a lack of effect (Cronin, 6020).

New York and New Jersey submitted testimony predicting the general effects of the New York plan upon salinity in the estuary, upon the oyster and upon its chief predator, the oyster drill (Cronin, 6022). The average effect upon those specific conditions may, as alleged by New York, be minor as compared with the variables produced by tidal action, seasonal weather and storms. Delaware contended that even these average changes may, however, have serious and deleterious effects not now foreseen (Cronin, 6022). Reduced spring flows may result in the attraction of fewer ocean fish into the Delaware Bay. These migrant and vagrant species provide most of Delaware's commercial and sports yield (Cronin, 6022). A modified summer flow may be deleterious to floating eggs of fish like the sea trout which use the Delaware estuary as a spawning area (Cronin, 6022). A reduced winter flow and modified summer flow may, in aggregate effect, reduce the crops of micro-organisms available to feed commercial species. Since oyster drill damage is a resultant of both salinity and temperature, the extended period of low flow in summer may more than offset the prevention of extremely low flow by allowing greater predation (Cronin, 6022).

The above are not predictions of harm to result from the diverted flow of Delaware River. As Dr. Cronin stated: Our knowledge of the hydrography of the estuary, of the detailed biology of the species, and of the future flow of the Delaware are all inade-

quate for such predictions. The plan may have possible effects upon the interests of Delaware and its citizens (Cronin, 6023).

In so far as Delaware is concerned continued surveys of the estuary and research upon hydrography and its biological effects are considered essential. These investigations will yield comprehension of the effects of further withdrawal of water and of natural fluctuating ecological conditions.

Another example of possible harm arising out of the proposed diversions is found in the salt water encroachment in aquifers or waterbearing strata adjacent to the Delaware River and the Delaware Bay. It was shown that salt water and fresh water, having different densities, do not readily mix in aquifers, but are separated by a relatively thin boundary zone (Groot, 6026). The location of this boundary zone depends primarily upon the difference in densities of the fresh and saline waters in the acquifer, and upon the rate of withdrawal of water from wells (Groot, 6026). As the density of water increases with a rise in salinity, the difference in the densities of fresh and saline water increases, thus facilitating salt water encroachment (Groot, 6026). In Delaware that encroachment of salt water has already occurred along the Delaware River and Bay in shallow acquifers which has resulted in the abandonment of such wells and the necessity of exploration for deeper ground water supplies (Groot, 6027). If, therefore, the proposed diversions result in abnormally high salinities, Delaware may be faced with a series of contaminated wells and a need for further exploration for other ground water supplies. Delaware agrees that it seems certain that the diversion of water as proposed will cause a decrease in the minimum flow of the river and will increase the salini-

ties that may prove detrimental to the quality of water in aquifers adjacent to the river. While Dr. Groot, the State Geologist of the State of Delaware, has not testified that the proposed diversion is presently harmful, he concluded that such diversion may become harmful to ground water supplies now being used by municipalities, industries and individuals, or may cause, in the future, contamination of great potential ground water supplies within the State of Delaware (Groot, 6028). Thus, again, the proposed diversions may cause irreparable harm to flow in the State of Delaware.

Cl. 5.045. River Master.

It. 5.0451. Contentions of New York.

In the present proceeding, New York originally contended that it is not necessary for a River Master to be appointed until such time as two or more of the parties undertake developments involving release works which are located above a common point of control (Kennison, 3141).

New York has now taken the position that it may be a satisfactory solution of the problem if the Chief Hydraulic Engineer of the United States Geological Survey or his representative acts as River Master.

It. 5.0452. Contentions of New Jersey.

The State of New Jersey has no objection to the appointment of a River Master, provided that his functions, obligations and limitations of authority are described in detail by the Court (Sherman, 1311-1312).

New Jersey subscribes to the proposal that the Chief Hydraulic Engineer of the United States Geological Survey, or his representative serve as River Master.

It. 5.0453. Contentions of Pennsylvania.

Pennsylvania vigorously urged that if the decree is modified at this time, a River Master be now appointed to administer the decree and obtain data regarding the relative water needs of the states in the Delaware Valley, to check and correlate stream flow gagings, to observe, record and study the extent of river development on the uses of the river, including water supply and other necessary, proper and desirable uses, and to make periodic reports (Greeley, 2095; Ryder, 2132).

It. 5.0454. Contentions of Delaware.

The State of Delaware joins the Commonwealth of Pennsylvania in advocating that the Court appoint a River Master who is to perform such functions as are prescribed by the Court.

ARTICLE 6

Recommendation for an Amended Decree

New York predicts permanent benefits to the other parties from its plan and maintains that Pennsylvania, New Jersey and Delaware have no basis for their assertions that the proposed diversions by the City of New York, when accompanied by the basic releases under the Montague formula, will cause damage to the other parties at any time. On the other hand, Pennsylvania, New Jersey and Delaware, while not showing any present damage, have adduced extensive proofs to the effect that the New York plan will cause them substantial damage in the future and strongly urge that they be given protection against that possibility if the New York plan be now authorized.

Having studied with great care the pleadings, the testimony, the exhibits and the briefs submitted in this cause, the Special Master recommends the making and entry of the Amended Decree hereinafter set forth.

This amended decree grants the prayer of the amended petition by authorizing the additional diversion sought by the City of New York and the substitution of the Montague release formula for that contained in the 1931 decree. For the protection of all parties, the amended decree continues in force the provisions of the 1931 decree that:

(1) The authorized diversions do not constitute prior appropriations; and

(2) The Court shall retain jurisdiction over the subject matter of the controversy in order to make such modifications of the amended decree as conditions hereafter may require.

In addition, the amended decree contains a suitable provision safeguarding each party against any possible

claim of estoppel in the future notwithstanding any action taken by any party under the terms of the proposed decree.

The amended decree also gives effect to suggestions of Pennsylvania respecting the terms of the Montague formula and the appointment of a River Master. It permits the diversion by New Jersey of 100 m.g.d. without compensating releases upon the conditions which were negotiated between New Jersey and Pennsylvania. No opposition to that diversion has been expressed by any party.

RECOMMENDED AMENDED DECREE

The Court, having considered the amended petition of the City of New York, joined by the State of New York, to which is appended the consent of the State of New Jersey, the answer filed by the State of New Jersey seeking affirmative relief and the answers filed by the Commonwealth of Pennsylvania and the State of Delaware, the evidence and exhibits adduced by the parties, and the report of Kurt F. Pantzer, Esquire, Special Master, and being fully advised in the premises, now enters the following order:

I. Report of Special Master Approved. The "Report of the Special Master Recommending Amended Decree", filed May 27, 1954, is in all respects approved and confirmed.

II. 1931 Decree Superseded. The decree of this Court entered May 25, 1931 (283 U. S. 805) is modified and amended as hereinafter provided and, upon the entry of this amended decree, the provisions of the decree of May 25, 1931, shall be of no further force and effect.

III. Diversions by the City of New York Enjoined Except as Herein Authorized. The State and City of New York are enjoined from diverting water from the Delaware River or its tributaries except to the extent herein authorized and upon the terms and conditions herein provided.

A. *Authorized Diversions.*

1. *440 M.G.D.* The City of New York may divert from the Delaware River watershed to its water supply system the equivalent of 440 million gallons daily (m.g.d.) until the City completes and places in operation its reservoir presently under construction on the East Branch of the Delaware River.

2. *490 M.G.D.* After the completion and commencement of operation of the East Branch reservoir, the City may divert the equivalent of 490 m.g.d. until the completion of its proposed dam and reservoir at Cannonsville on the West Branch of the Delaware River, provided, however, that in the event of an abnormal or unforeseeable interruption of its facilities, the City may divert in excess of the equivalent of 490 m.g.d. to meet its emergency requirements, but in no event shall such diversion impair the obligation of the City to make the releases hereinafter specified.

3. *800 M.G.D.* After the completion of the Cannonsville reservoir, the City may divert the equivalent of 800 m.g.d.

4. *Computation of Diversion.* At no time during any twelve-month period, commencing June 1, shall the aggregate total quantity diverted, divided by the number of days elapsed since the preceding May 31, exceed the applicable permitted rate of diversion.

B. *Conditions and Obligations Imposed in Connection With Diversions and Releases by City.* The diversions and releases by the City of New York from the Delaware River shall be made under the supervision and direction of the River Master, hereinafter appointed, and shall be subject to the following conditions and obligations:

1. *Compensating Releases—The Montague Formula.* The City shall release water from its reservoirs as follows:

(a) Until the East Branch reservoir is completed and placed in operation, on the day following each day in which the average flow in the Delaware River falls short of 0.50 cubic feet per second per square mile (c.s.m.), either at Montague, New Jersey (below the mouth of the Neversink River), or at Trenton, New Jersey (0.50 c.s.m.

being equivalent to a flow of 1740 cubic feet per second (c.f.s.) at Montague and 3400 c.f.s. at Trenton), the City shall release water from the Neversink reservoir at an average of 0.66 c.s.m. or 61.38 c.f.s.

(b) Upon the completion and placing in operation of the Neversink and East Branch reservoirs, the City shall release water from one or more of its storage reservoirs in the upper Delaware watershed. Such releases shall be in quantities designed to maintain a minimum basic rate of flow at the gaging station of the United States Geological Survey (U.S.G.S.) at Montague of 1525 c.f.s. (985.6 m.g.d.) until the Cannonsville project is completed and its reservoir first filled to the extent that 50 billion gallons above the lowest outlet are available for diversion and release, and of 1750 c.f.s. (1131.1 m.g.d.) thereafter. Compliance by the City with directions of the River Master with respect to such releases shall be considered full compliance with the requirements of this subsection (b).

(c) At the commencement of the calendar year following the completion and placing in operation of the Neversink and East Branch reservoirs and of each calendar year thereafter, the City of New York shall estimate and report to the River Master the anticipated consumption of water during such year to be provided for by the City from all its sources of supply. The City shall, as hereinafter provided, release in the aggregate from all its storage reservoirs in the upper Delaware watershed, in addition to the quantity of water required to be released for the purpose of maintaining the then applicable minimum basic rate of flow as hereinabove provided, a quantity of water equal to 83 per cent of the amount by which the estimated consumption during such year is less than the City's estimate of the continuous safe yield during such

year of all its sources obtainable without pumping. In any such year the City's estimate of anticipated consumption shall not exceed by more than 7¼ billion gallons the actual consumption in any previous calendar year; and its safe yield in any such year, obtainable without pumping, shall be estimated at not less than 1355 m.g.d. after the Neversink and East Branch reservoirs are put into operation; and at not less than 1665 m.g.d. after the Cannonsville reservoir is put into operation. If, at any time after the completion of the Cannonsville reservoir and prior to the year 1993, the continuous net safe yield for water supply of all of the City's sources of water supply, obtainable without pumping, is increased by the development of additional sources, such greater safe yield shall be used in determining the excess releases.

(d) The City of New York shall release the excess quantity provided for in subsection (c) at rates designed to release the entire quantity in 120 days. Commencing with the fifteenth day of June each year, the excess releases shall continue for as long a period, but not later than the following March 15, as such additional quantity will permit. Such period is hereinafter referred to as the "seasonal period". The excess quantity required to be released in any seasonal period shall in no event exceed 70 billion gallons. In releasing the excess quantity specified for any seasonal period, the City shall not be required to maintain a flow at Montague greater than the applicable minimum basic rate plus the excess quantity divided by 120 days, or in any event greater than 2650 c.f.s., nor to release at rates exceeding the capacity of its release works. The City shall in each seasonal period continue its excess releases until March 15 or until the aggregate quantity of the flow at Montague in excess of the basic rate or in excess of such higher rates as are not the result of the City's prior releases, is equal to the total specified excess quantity.

(e) The terms and conditions provided in subsections (b), (c) and (d) hereof shall continue to be applicable in all respects in the event that the U.S.G.S. gaging station at Montague shall be relocated at a point below the confluence of the Neversink River with the Delaware River.

2. *Minimum Capacity of Release Works at Reservoirs of City.* In constructing the Cannonsville reservoir, the City shall install release works of such capacity as will provide a minimum aggregate release capacity from all its reservoirs in the Delaware River watershed of not less than 1600 c.f.s. under conditions of maximum reservoir depletion.

3. *Releases to be Continued in Spite of Interference.* In the event that any works hereafter constructed by public or private interests in the watershed of the Delaware River outside of the State of New York shall prevent the proper operation of the U.S.G.S. gaging station at Montague or interfere with the effective operation of the above release requirements by diverting water past the station or by intercepting the natural flow and storing it in reservoirs with an aggregate storage capacity in excess of 25 billion gallons, the City of New York shall continue to make the releases above specified which would be required in the absence of such interference, and appropriate gaging stations shall be established for that purpose.

4. *Inspection Permitted.* The States of New Jersey and Delaware and the Commonwealth of Pennsylvania, through accredited representatives, and the River Master, shall at all reasonable times have the right to inspect the dams, reservoirs and other works constructed by the City of New York, to inspect the diversion areas and the inflow, outflow and diverted flow of such areas, to inspect

the meters and other apparatus installed by the City of New York and to inspect all records pertaining to inflow, outflow and diverted flow.

IV. Treatment of Port Jervis Sewage. The effluent from the sewage treatment plant at the City of Port Jervis, New York, shall be treated so as to effect a reduction of 85 per cent in the organic impurities and shall be treated with a chemical germicide, or otherwise, so that the B. coli originally present in the sewage shall be reduced by 90 per cent. Untreated industrial waste from plants in the City of Port Jervis shall not be allowed to enter the Delaware and Neversink Rivers. The treatment of such industrial wastes shall be such as to render the effluent practically free from suspended matter and nonputrescent. The treatment of both sewage and industrial waste shall be maintained so long as any diversion is made from the Delaware River or its tributaries.

V. Diversions by New Jersey Authorized under Specified Conditions.

A. *Authorized Diversions.* The State of New Jersey may divert outside the Delaware River watershed, from the Delaware River or its tributaries in New Jersey, without compensating releases, the equivalent of 100 m.g.d., if the State shall not, prior to July 1, 1955, repeal Chapter 443 of the New Jersey Laws of 1953, and if, when the Commonwealth of Pennsylvania accepts the conditions as specified in Section 19 of that Chapter, the State of New Jersey shall join with the Commonwealth of Pennsylvania in requesting the consent of Congress to the agreement embodied in Chapter 443 of the New Jersey Laws of 1953 and an Act of the Commonwealth of Pennsylvania accepting the conditions of such New Jersey Act.

B. *Conditions and Obligations Imposed in Connection with Diversions by New Jersey.* The diversions by New Jersey from the Delaware River shall be made under the supervision of the River Master and shall be subject to the following conditions and obligations:

1. Until the State of New Jersey builds and utilizes one or more reservoirs to store waters of the Delaware River or its tributaries for the purpose of diverting the same to another watershed, the State may divert not to exceed 100 m.g.d. as a monthly average, with the diversion on any day not to exceed 120 million gallons.

2. If and when the State of New Jersey has built and is utilizing one or more reservoirs to store waters of the Delaware River or its tributaries for the purpose of diversion to another watershed, it may withdraw water from the Delaware River or its tributaries into such impounding reservoirs without limitation except during the months of July, August, September and October of any year, when not more than 100 m.g.d. as a monthly average and not more than 120 million gallons in any day shall be withdrawn.

3. Regardless of whether the State of New Jersey builds and utilizes storage reservoirs for diversion, its total diversion for use outside of the Delaware River watershed without compensating releases shall not exceed an average of 100 m.g.d. during any calendar year.

VI. Existing Uses not Affected by Amended Decree. The parties to this proceeding shall have the right to continue all existing uses of the waters of the Delaware River and its tributaries, not involving a diversion outside the Delaware River watershed, in the manner and at the locations presently exercised by municipalities or other governmental agencies, industries or persons in the Delaware

River watershed in the States of New York, New Jersey and Delaware and the Commonwealth of Pennsylvania.

VII. River Master.

A. *Designation.* Subject to the concurrence of the Director of the U. S. Geological Survey, the Chief Hydraulic Engineer of the U. S. Geological Survey, or such other engineer of the U. S. Geological Survey as shall at any time be designated by the Chief Hydraulic Engineer, is hereby designated as River Master.

B. *Duties.* The River Master shall either in person or through his assistants possess, exercise and perform the following duties and functions:

1. *General Duties.*

(a) Administer the provisions of this decree relating to yields, diversions and releases so as to have the provisions of this decree carried out with the greatest possible accuracy;

(b) Conserve the waters in the river, its tributaries and in any reservoirs maintained in the Delaware River watershed by the City of New York or any which may hereafter be developed by any of the other parties hereto;

(c) Compile and correlate all available data on the water needs of the parties hereto;

(d) Check and correlate the pertinent stream flow gagings on the Delaware River and its tributaries;

(e) Observe, record and study the effect of developments on the Delaware River and its tributaries upon water supply and other necessary, proper and desirable uses; and

(f) Make periodic reports to this Court, not less frequently than annually, and send copies thereof to the Governors of Delaware, New Jersey, New York and Pennsylvania, and to the Mayor of the City of New York.

2. *Specific Duties with Respect to the Montague Release Formula.* In connection with the releases of water which the City of New York is required to make under Par. III-B-1(b) of this decree, the River Master, in co-operation with the City of New York, shall, by appropriate observation and estimates, perform the following duties:

(a) Determine the average times of transit of the flow between the release works of the several reservoirs of the City and Montague and between the release works of other storage reservoirs in the watershed and Montague;

(b) Make a daily computation of what the average flow observed on the previous day at Montague would have been, except for that portion previously contributed by releases of the City or as affected by the contributing or withholding of water at other storage reservoirs, for the purpose of computing the volume of water that would have had to be released in order to have maintained precisely the basic rate on that day;

(c) Take account of all changes that can be anticipated in the flow from that portion of the watershed above Montague not under the City's control and allow for the same by making an appropriate adjustment in the computed volume of the daily release; and

(d) After taking into consideration (a), (b) and (c), direct the making of adjusted daily releases designed to maintain the flow at Montague at the applicable minimum basic rate.

C. *Distribution of Costs.* The compensation of, and the costs and expenses incurred by, the River Master shall be borne equally by the State of Delaware, State of New Jersey, Commonwealth of Pennsylvania, and the City of New York.

D. *Replacement.* In the event that for any reason the Chief Hydraulic Engineer of the U.S.G.S. or his designee cannot act as River Master, this Court will, on motion of any party, appoint a River Master and fix his compensation.

VIII. No Prior Appropriation nor Apportionment. No diversion herein allowed shall constitute a prior appropriation of the waters of the Delaware River or confer any superiority of right upon any party hereto in respect of the use of those waters. Nothing contained in this decree shall be deemed to constitute an apportionment of the waters of the Delaware River among the parties hereto.

IX. Decree Without Prejudice to the United States. This decree is without prejudice to the United States. It is subject to the paramount authority of Congress in respect to commerce on navigable waters of the United States; and it is subject to the powers of the Secretary of the Army and Chief of Engineers of the United States Army in respect to commerce on navigable waters of the United States.

X. Retention of Jurisdiction; No Estoppel. Any of the parties hereto, complainant, defendants or intervenors, may apply at the foot of this decree for other or further action or relief, and this Court retains jurisdiction of the suit for the purpose of any order or direction or modification of this decree, or any supplemental decree that it may

deem at any time to be proper in relation to the subject matter in controversy. The fact that a party to this cause has not filed exceptions to the report of the Special Master or to the provisions of this decree shall not estop such party at any time in the future from applying for a modification of the provisions of this decree, notwithstanding any action taken by any party under the terms of this decree.

XI. COSTS OF THIS PROCEEDING. The costs of this proceeding shall be paid by the parties in the following proportions: State of New Jersey, 26⅔ per cent, City of New York, 26⅔ per cent, State of New York, 10 per cent, Commonwealth of Pennsylvania, 26⅔ per cent, and State of Delaware, 10 per cent.

Respectfully submitted,

KURT F. PANTZER,
Special Master,

LOCATION	WATER-SHED SQ.MI.	STORAGE BILLION GALLONS	REFERENCE
FOR NEW YORK CITY			
EXISTING SURFACE SOURCES			
(A) Croton System	375	103.1	Huie p.8
Catskill System			
(B) Ashokan Res.	257	130.5	Huie p.9
(C) Schoharie Res.	314	19.6	
(D) Hudson River, including Chelsea emergency plant and Hyde Park	.....	0	
Delaware System			
(E) Rondout Res	95	48.7	Huie p.10 et.seq.
(F) Neversink Res.	93	34.7	
(G) Pepacton Res.	372	143.5	
PROPOSED			
(H) Cannonsville Res.	450	91.2	
IN NEW JERSEY			
EXISTING SURFACE SOURCES			
(I) Del. & Raritan Canal	.....	0	Critchlow pp.1009-
(J) Wanaque Res.	95	29.5	1012, 1019
(K) Ramapo River	.....	0	p.1015
(L) Pequannock River Res.	64	.....	
(M) Rockaway River Res.	119	.....	
(N) Hackensack Water Co. Res.	115	3.7	
(O) Passaic Valley Water Comm.	.....	.....	
(P) Lawrence Brook Res.	.....	.....	
(Q) Swimming River Res.	.....	.....	
Minor Supplies shown thus ➡			
PROPOSED			
(R) Musconetcong River	123	.....	pp.1021. 1023
(S) Flat Brook Res.	65	62.7	
(T) Pequest River Res.	116	5.8	
(U) Paulins Kill Res.	124	17.3	
(V) Beaver Brook Res.	32	19.5	
(W) Round Valley Res.	.....	.....	p.1021, N.J. Ex.2
(X) Dock Watch Hollow Res.	.....	.....	p.1020
IN PENNSYLVANIA			
EXISTING SURFACE SOURCES			
(Y) Octoraro Creek Res.	139	2.5	Haseltine p.2195
(Z) Wild Creek Res.	22	4.1	Ryder p.2102
(AA) Torresdale Intake			
(BB) Schuylkill Intake			
PROPOSED			
(CC) Wallpack Bend Res.	3735	95.	Ryder p.2104
(DD) Nescopeck-Lehigh Res.	319	150.	
IN DELAWARE			
EXISTING SURFACE SOURCES			
(EE) Edgar Hoopes Res.	2	2.2	
(FF) Delaware Water Co. Res.	48	0.008	

..... Data unknown.

PRINCIPAL WATERSHED AREAS

Above the Capes	12,871 square miles
Pennsylvania-Delaware State Line	10,377
Trenton	6,780
Montague	3,480